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INTRAPELVIC PROTRUSION OF THE ACETABULUM¹

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THE subject matter of the following communication refers to a rather uncommon hip condition characterized by deepening of the acetabular cavity and inward protrusion of the medial wall of the acetabulum. There is an associated disturbance in hip function, with limitation of abduction, rotation, and frequently of flexion and extension.

This condition was first described by Otto (1) in 1824 as an osteo-arthritis. Since that time approximately fifty cases have been reported, showing that it is not a common lesion, although in our experience it is much more common than the number of reported cases would indicate. In 1921 Valentine and Mueller (2) collected thirty-one cases from the literature but only about twenty were of the particular type under discussion. They described a number of etiological causes in the various cases. Wolfsohn and Brandenstein (3) have introduced the name "juvenile osteo-arthritis," which would seem to be descriptive of certain cases, but the majority of these patients are much too old and their symptoms are of too recent origin to be classed under this name.

Various infectious agents have also been charged with being the causative factor. Esau (4) believes a low-grade pyogenic in-

fection to be the cause. The gonococcus is claimed to be the etiological agent by Chiari (5) and Schlagenhauser (6). Féré (7) and Wrede (8) have described this condition in tabes where there is marked overproduction of bone. This, however, is not the typical condition which we are describing.

Saupe (9) in a recent article describes a case which came to autopsy and showed destruction of the bony surface of the acetabulum. The floor was sclerotic, with an ivory-like appearance, and was thickened about one centimeter. The protrusion extended two centimeters into the pelvis. Campbell (10) believes that the change is brought about by a destruction of one side of the acetabulum and new bone production on the other caused by a reactive process in the periosteum of the inner side of the pelvis. Loebel (11) recently reported three cases, all women. He thinks the typical case is caused by polyarthritis plus the pressure of the head of the femur in the acetabulum. Zwicker (12) has also recently reported seven cases but several of these are not of the type under consideration. Benda (13) has drawn attention to the fact that this condition may be so severe as to be a very serious obstetrical problem, and may even necessitate a cesarean section.

The first description of this condition in

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Fig. 1, Case 1.

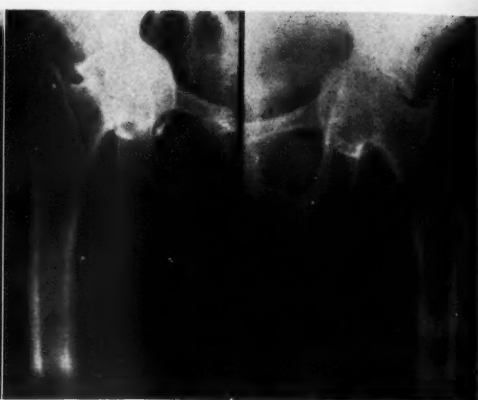


Fig. 2, Case 2.

the American literature which we have found is by Hertzler (14), who reports four cases. One of these cases is of the type due to arthritis and one is of the type described by Esau (4). The other two were due to tuberculosis and malignancy, respectively, and do not figure in this discussion. Case reports by Pomeranz (15) and Lewin (16) were also found in the American literature. These are both of the osteo-arthritic type.

Eppinger (17) believes that this condition may be caused by a delayed ossification of the bones going to make up the acetabulum and that the pressure of the head of the femur against this is sufficient to cause protrusion. One of my cases might be caused by something of this nature.

CASE REPORTS

Case 1. E. D., female, aged 16. Complained of pain in the left hip. There was a history of a fall two years previously, striking this hip.

Physical examination revealed considerable disturbance in the function of both hips. The trochanters were less prominent than normal. Abduction was limited to about one-quarter of the normal range on

both sides. Hyperextension was impossible and flexion stopped at ninety degrees. There was practically no internal rotation. The Wassermann was negative. History of typhoid fever at age of fourteen. The examination was otherwise negative.

Roentgen examination of the pelvis revealed a similar deformity of both hips. The acetabuli were much deepened, allowing the heads and a portion of the necks of the femora to extend into them. The medial walls of both acetabuli were very much thinned and showed only as very narrow dense lines. The heads of the femora were somewhat octagonal in shape but there was no apparent bone destruction nor obliteration of the joint cartilage.

Case 2. M. K., female, aged 50. Complained of rheumatism, with pain running down the backs of the legs for the past four years.

Examination showed flexion deformity of about twenty degrees of both hips. There was practically no rotation in either the flexed or extended positions. Abduction was limited to about thirty degrees. Wassermann negative. History of typhoid some years previously.

Roentgen examination of the pelvis disclosed a condition involving both hips, very



Fig. 3, Case 3.

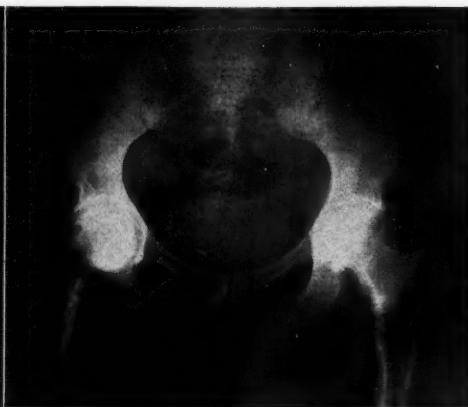


Fig. 4, Case 4.

similar to that seen in Case 1, above. In this, however, the medial wall of the acetabulum was slightly thicker and there appeared to be some narrowing of the joint space but no definite bone destruction.

Case 3. I. M., female, aged 49. Complained of pain in the lower back and stiffness of the legs for about one year.

Examination disclosed marked spasticity of all the muscle groups of the lower extremities, especially the adductor group. There was no limitation of flexion or extension of the hips. The pain was somewhat indefinite and not typical of arthritic pain but suggested some central nervous lesion. Wassermann negative. History of scarlet fever in early life.

Roentgen examination of the spine and hips showed evidence of chronic infectious arthritis of the spine and both hips. The hips also showed some deepening of the acetabuli and a thinning of the medial wall.

Case 4. L. B., female, aged 53. Complained of low back pain for five years.

Examination of the hips disclosed a limitation of abduction of the hips on both sides and absolute restriction of rotation. There was also some restriction of flexion and extension. The tip of the greater tro-

chanter was higher than normal. There was pronation of both feet, accompanied by internal rotation, which she states has been present since childhood. Wassermann negative. History of scarlet fever at age of seven with chronic ear trouble resulting.

Roentgen examination of the hips showed the heads of the femora to be rather deep set in the acetabuli and there was definite evidence of chronic arthritis of the hips and lower spine. The articular margin of the acetabuli showed definite eburnation.

Case 5. D. T., female, aged 44. Complained of pain in the hips, radiating down the legs, of seven years' duration, but worse during the past year.

Physical examination disclosed a marked lumbar lordosis, with limitation of flexion. The hips showed flexion deformity to a considerable degree and no external rotation was possible. Abduction was limited and adduction very markedly limited. Wassermann negative. History of scarlet fever, measles, and influenza in the past.

Roentgen examination showed a deformity involving both hips. The inner margins of the acetabuli were thinned and eburnated. There was evidence of bone destruction and proliferation involving both the heads of



Fig. 5, Case 5.



Fig. 6, Case 6.

the femora and the acetabuli. There was some narrowing of the joint spaces indicating cartilaginous destruction. There appeared to be some change in the contour of the pelvic outline, although this might have been partly caused by the extreme lordosis.

Case 6. E. F., male, aged 35. Complained of shooting pains in the left hip during the past year and a half. There was a history of similar trouble in the right hip about eighteen years previously, accompanying dislocation. That hip was in a cast for fourteen weeks and has been ankylosed since. Examination revealed solid ankylosis of the right hip and limitation of movements of the left hip on manipulation. Wassermann negative. No infectious diseases in the past.

Roentgen examination of the pelvis disclosed complete ankylosis of the right hip. The left acetabulum was somewhat deeper than normal and there was thinning and eburnation of the medial wall. There was also evidence of infectious arthritis present.

Cases 7 and 8 are reported through the courtesy of Dr. W. F. Henderson, of Touro Infirmary, New Orleans, La. Both cases are in women. One was in the third and the other in the fourth decade of life. Neither had borne children. Both were admitted

for examination because of alteration in their normal gait. They both denied any accidents or pains in the joints in the past. Nothing in the history of either case suggested any etiological factor.

Roentgen examination revealed deepening of the acetabulum, with thinning and eburnation of the medial wall. There was narrowing of the joint space showing cartilaginous absorption and lipping around the upper lateral margin of the acetabulum suggesting arthritic changes. The femoral head was deeply buried in the acetabulum and the greater trochanter was higher and closer to the ilium than normal. The roentgen changes in these two cases were almost identical.

CLINICAL FINDINGS

The symptoms in these cases vary according to the amount of pathology present and the primary etiology. In a number of cases the chief complaint is a "waddling gait," which may be first noticed by the patient's friends. On examination, such an individual is found to have limitation of motion of the leg. In other cases the symptoms are those of chronic infectious arthritis, namely, pain, tenderness, and limitation of

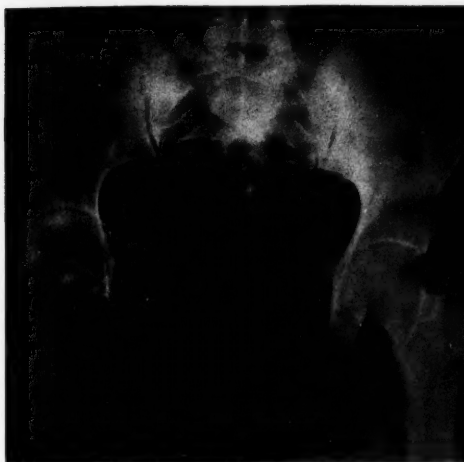


Fig. 7, Case 7.

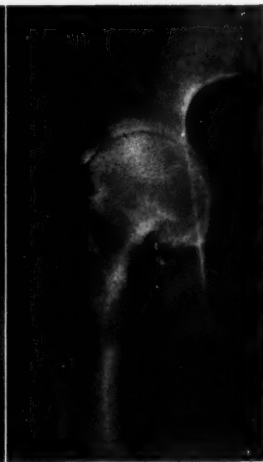


Fig. 8, Case 8.

motion, with spasm of certain groups of muscles. There is practically always limitation of abduction and rotation. There may be complete bony ankylosis.

ROENTGEN CHANGES

The changes in the acetabulum are the most striking. There is a very definite thinning of the mesial and inferior wall of the acetabulum, with a protrusion of this into the pelvic cavity. This thin wall of the acetabulum has a rather constant appearance. It is thicker in its upper or iliac portion and thins out as it progresses downward. It shows considerable eburnation, which is apparently an effort on the part of Nature to lay down a thin, dense wall to sustain the weight-bearing thrust of the head of the femur. The changes noted in the typical case are confined to the acetabulum and do not involve the adjacent parts of the pelvis. In those atypical cases caused by malignancy, osteomyelitis, etc., the other parts of the pelvis may be involved.

The changes in the head of the femur are variable. In some cases there are no apparent changes, while in others there is extensive lipping suggestive of arthritic changes.

Occasionally where the acetabular protrusion is irregular the outline of the femoral head may closely correspond to those irregularities. In Case 1 of our series the articular surface of the head is roughly octagonal in shape. The neck of the femur may appear to be shorter than normal, but this is often the result of the head of the femur being deeply buried in the acetabulum or else due to the extensive lipping, projecting outwards like a bony shell over the femoral neck.

The head of the femur, being more deeply buried in the acetabulum, it naturally follows that the greater trochanter is much closer to and may even impinge on the ilium. It is apparent, therefore, that most of the limitation of abduction and rotation is due to mechanical factors. This would also limit the other movements to a greater or lesser degree, depending on the physical factors in any given case. There is frequently absorption of cartilage, with narrowing of the joint space.

DISCUSSION

We have tried to limit our discussion of inward acetabular protrusion to those cases which are more or less typical of the type

first described by Otto (1), and which have a fairly typical appearance, as described above. Several of our cases vary slightly from the typical well-developed case, but would appear to be stages of the same process. We have avoided those cases caused by injury, osteomyelitis, malignancy, etc., as they are different from the type under study, which, so far, has no known etiology. This is a rather rare condition, as evidenced by the fact that probably less than fifty cases are reported in the literature.

One of the most fascinating aspects of this study is the consideration of its etiology. The various ascribed causes have been mentioned in a recent article by Saupe (9). He mentions as possible causes, trauma, bad posture, kyphosis, spondylolisthesis; special influences, as climacteric, tuberculosis, gonorrhea, tabes, typhus, osteomyelitis, osteitis deformans, tumors, and echinococcosis. While it is conceivable that any of these may be the cause of an individual case, a careful study of this subject will soon rule these out as the true cause of this condition. Saupe also mentions the following causes: congenital disturbance in growth, osteitis deformans juvenilis, coxitis of various kinds, osteomalacia, and polyarthritis. These are less easily disposed of, but, on the other hand, it is difficult to prove the existence of these conditions in the cases studied, with the possible exception of polyarthritis. This has the greatest number of adherents among those writing on this subject. It is supported by the fact that a majority of the patients are in the age period in which arthritis occurs, and by the fact that many of the patients have other evidence of arthritis. Loebel (11) reports one patient whose symptoms were relieved by inhalation of radium emanation. Campbell (10) explains the protrusion in arthritis as being caused by a destructive process affecting the inner surface of the acetabulum and a reactive process being set up in

the periosteum on the pelvic side, with consequent new bone formation. He believes that such a membranous stage must be confined to small parts of the acetabulum, as involvement of the entire acetabulum at one time would probably lead to perforation. Phemister (18) suggests that this may be due to osteo-arthritis, in which the outstanding osteo-involvement is found in the acetabulum in contrast with the head of the femur.

In analyzing the eight cases which we report it is found that the ages vary from 16 to 53. Seven were females and one was a male. Of the females, only two had borne children. The Wassermann was negative in all cases. Two cases had had typhoid fever and three had had scarlet fever, but nothing could be found in the histories to connect any infectious disease with the causation of this condition. The condition was bilateral in five cases and unilateral in three cases. The duration of symptoms varied from one to seven years, with an average of three and one-half years. On physical examination the most constant finding was restriction of or absence of abduction of the leg, a condition which was present in all cases. The next most common finding was restriction of rotation, present in all cases but one. In a majority of the cases there was also some restriction of flexion and hyperextension.

Several points bearing on the etiology may be gleaned from this analysis and from a study of the films of these cases. Several of these patients complained only of altered gait and restriction of motion, with rather recent origin of the symptoms. In one of the most marked cases (Case 1), with bilateral symmetrical involvement, the patient was only 16 years of age and her complaint dated only from a recent slight injury. These facts are not entirely consistent with an osteo-arthritic etiology.

Study of the films suggests a mild degree

of coxa vara in several of the cases (Cases 1, 2, and 3), on either one or both sides. In Cases 1, 2, and 7 the pelvis would appear to be slightly contracted. This brings up the question as to whether this condition might be caused by some general disease, such as osteomalacia or rickets, producing a general bone softening with resultant coxa vara and inward protrusion of the acetabuli due to the weight of the trunk pushing downward on the heads of the femora. Against this, however, is the fact that the deepening of the acetabulum is unlike that seen in osteomalacia, where the entire bony pelvis bulges inward. We were unable to find any evidence of these diseases elsewhere in the bodies of these patients.

SUMMARY

Eight cases of inward protrusion of the acetabulum are presented. A study of the literature shows this to be a rather rare condition although first described in 1824. The literature shows a considerable variance of opinion as to the exact etiology. Our study of the literature and of our cases has also failed to disclose any one etiological factor. We believe that several factors may enter into its production. Osteo-arthritis appears to be the most constant accompaniment of this condition and this may be a manifestation of arthritis where the involvement is of the acetabulum rather than of the head of the femur. We would suggest, however, that this could best be explained by some general disease in early life causing softening of the bones with resultant deformity and that osteo-arthritis is a later stage in the process.

The clinical findings refer mostly to pain and restriction of the normal motion of the hip. The roentgen picture discloses a deepening of the acetabulum, with thinning of the mesial and inferior wall. The head of the femur is, therefore, more deep-

ly buried and the greater trochanter is somewhat higher and closer to the ilium.

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DISCUSSION

DR. E. S. BLAINE (Chicago): Concerning Dr. Doub's presentation, his illustrations remind me of the condition known as Legg-Calvé-Perthes' disease. Pathologists are still somewhat in doubt as to the exact pathology present in these cases. The X-ray shadows seem to indicate a bone softening process and probably represent some fault in the trophic nerve supply of the head of the femur; while in the cases under discussion the same process may be in the acetabular cavity. In the young individual we have to deal with a richer amount of immature cells, varying from cartilage cells to more or less ossified bone. In the cases he has shown, the majority are in adults, that is, after the cartilage has changed to fully developed bone. One may properly question whether or not in these cases—the majority of whom are women—the lesions did not originate before full osseous development of the skeletal system occurred. The protrusion of the head of the femur into the deepened acetabular cavity of an otherwise normal hip joint is very striking. In the case where the head of the femur had almost penetrated the floor and almost bulged into the pelvic bone the mechanics of the process seem to me to be based on a traumatic condition and seem to be an exaggeration of some inflammatory bone condition confined to the acetabulum.

Also, the possibility that this lesion is similar to or allied with the changes of osteochondritis dissecans, which frequently give no symptoms at all, and in the phlegmatic individual are hardly ever recognized, should be considered. In this condition we

may find, on opening such a joint, that only one surface is involved, and, as in Dr. Doub's cases, apparently only the acetabular side, with possibly one or two exceptions. It seems to me that this is a question of an atypical bone infection, and eventually we may have proof that such is the case. This is partially supported by the apparent increase of bone on the back or inner side of the ischium, which is, in reality, a reactive process, and seems to be an attempt of Nature to bolster up or reinforce a weakened structure. In the few cases which I have encountered that seem to be more or less similar to those presented by Dr. Doub, the lesion was unilateral. I note that five out of the eight presented are bilateral; therefore, one should consider the possibility that this is a part of a multiple deforming arthritis. I would ask Dr. Doub to tell us whether or not he made X-ray examination of other than the hip joints of these cases and, if so, if he found anything that could be considered as suggesting a similar change. As he aptly states it in his paper, we still have much to learn regarding these unusual and evidently rare hip joint lesions.

DR. L. T. LEWALD (New York): I would like to say a word about Dr. Doub's cases: they are classical and very well presented. I have seen one case of unilateral lesion of this type, which I have regarded as probably due to traumatism not recognized at the time of the injury as sufficient to have caused incapacity. From Dr. Doub's presentation, I shall now regard that case, in the absence of a definite trauma, as one of the type which he has so clearly presented to us.

A ROENTGENOLOGIC CONSIDERATION OF DUODENITIS¹

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IN 1921 Judd called attention to two distinct lesions in the duodenum, either of which may be found when there is a characteristic history of peptic ulcer. The first is the true ulcer, which is recognized by the congestion and stippling of the serosal surface, with the production of more or less scar tissue and deformity of the duodenum. The wall of the duodenum is always indurated, and a tumor may form as a result of the defensive reaction of the surrounding tissues if the ulcer has perforated the bowel slowly. When the duodenum is opened a crater ulcer is seen. The second type he called "duodenitis," or "submucous ulcer," which is characterized by congestion and stippling of the serosa, with little or no induration. When the bowel is opened a lesion of the mucosa cannot be found, or, at most, only small superficial mucosal abrasions, but a localized or diffuse inflammatory condition of the duodenal mucosa which bleeds easily on manipulation is present. Often there is a tendency to circular constriction of the bowel, but it is difficult to determine whether this is due to spasm or true narrowing. Judd concluded that duodenitis is not a stage from which true ulceration invariably develops, as shown by the fact that the average duration of symptoms of the two lesions is about the same in the series of cases that he studied.

Konjetzny, in 1924, declared that in every one of twenty-two cases of duodenal ulcer pronounced chronic, gastritis and duodenitis were present, and in 54.5 per cent of them there were also fine and coarse mucosal defects. He believes that duodenitis is antecedent to duodenal ulcer, and that chronic ulcer forms as a result of unknown func-

tional mechanical factors on the basis of chronic duodenitis.

MacCarty reviewed a large number of excised inflammatory duodenal areas and found that the inflammatory reactions in duodenitis do not differ from those seen in other portions of the gastro-intestinal tract. There are cellular destruction, congestion, edema, migration of leukocytes, lymphocytes, and endothelial leukocytes. The lesion may be localized or diffuse; if it is diffuse the appearance of the organ at exploration is not readily confounded with that of duodenal ulcer, but if it is localized the external appearance of the serosa is sometimes indistinguishable from that seen in association with small true ulcers.

In addition to the foregoing changes, Wellbrock also noted apparent hyperplasia of Brunner's glands both above and below the muscularis mucosæ. In advanced cases definite fibrosis occurs. The thickness of the serosal coat varies; in some instances it is thick and edematous, and contains well formed blood vessels.

In order to investigate the roentgenologic aspects of the disease and their relation to the surgical and pathologic data, the records of forty-five recent consecutive patients examined and operated on at The Mayo Clinic were studied. The series was confined rigidly to examples of duodenitis alone, and cases of duodenitis associated with definite ulceration were not included.

Clinically, the disease in this group did not present salient points of distinction from frank ulcer of the duodenum. Thirty-six of the patients were men and nine were women; the average age was thirty-nine. The mean duration of symptoms was seven years. The average acids were: Total 55, and free hydrochloric acid 29. Sympto-

¹Read before the Radiological Society of North America, at Chicago, Illinois, December 3 to 7, 1928.



Fig. 1. Small greatly deformed duodenal bulb, hazy in outline, typical of duodenitis.



Fig. 2. Same type as shown in Figure 1.

matic relief was obtained from food or soda in approximately four-fifths of the cases. Bleeding, either obvious or occult, was recorded in nine cases, 20 per cent of the series.

At operation the surgeon, after taking note of the external appearance of the duodenum, opened it for inspection of its mucosal surface. Deformity of the duodenal wall, usually of only slight degree, was remarked in only six cases, the wall being quite smooth in the remaining thirty-nine. Undue localized blanching of the serosal surface attributed to the deposition of connective tissue was noted in twenty-two cases, although it was not comparable in degree or appearance with the scarring resulting from a healed ulcer. Stippling, radiating hyperemia of the serosa, was already present or could be evoked by manipulation in twenty-two cases, and boggy thickening of the wall could be felt in an equal number. When the duodenum was opened the con-

gested and edematous mucosa characteristic of duodenitis was visible in every case. In two cases minute areas of superficial erosion could be seen, but a true ulcer was not found in any case. In thirty cases the inflammatory process was localized to an area of small or moderate extent, and in fifteen it was widespread and diffuse.

In thirty-eight cases tissue was excised from the affected area for examination by the pathologist. In every instance the histologic changes were typical of those observed and recorded by MacCarty, Konjetzny, and Wellbrock.

On reviewing the films and roentgenoscopic data certain roentgenologic differences between duodenitis and frank duodenal ulcer become apparent.

1. As a rule the bulb is quite irritable, greatly deformed and diminished in size; often it is represented by a mere skeleton of barium content. Margins of the bulbar shadow tend to be hazy and indistinct. Ap-

parently the bulb is highly irritable, characterized by writhing and rapid emptying, thus making it difficult to fill the bulb for any length of time, and the spastic deformity is not only more pronounced than that produced by a true ulcer but it is also more unstable. To this rule there are occasional exceptions, the contour of the distorted bulb being immobile and sharply defined.

2. Since a crater is lacking, a marginal niche or central barium fleck cannot be seen. By manipulation the examiner may transitorily pen up a bit of barium in a spastic recess and mistake the latter for a niche, but its inconstancy should put him on guard.

3. In the absence of organic stenosis a residue from the six-hour meal should not remain in the stomach. This contrasts with the fact that gastric retention occurs in more than one-fourth the cases of true ulcer. In only one of the forty-five cases of duodenitis was a gastric residue observed and in this instance it was attributable to accompanying hypertrophy of the pyloric muscle.

4. In five cases (11 per cent) the roentgenologic diagnosis was negative; to warrant a negative report the bulbar contour must have appeared, at least momentarily during the examination, to be normal. Erroneous negative diagnoses of duodenal ulcer, all types included, ordinarily should be less than 5 per cent.

In other respects the roentgenologic manifestations in this series of cases were like those of non-obstructive ulcer. In general the stomach was small and hypertonic, and its peristalsis was exaggerated, sometimes irregular. In short, the stomach appeared to share the irritability of the bulb.

Although the series of cases is too brief to warrant any substantial deductions it arouses speculation as to the feasibility of roentgenologic distinction between duodenitis and typical ulcer. One obstacle to this distinction is the fact that duodenitis and

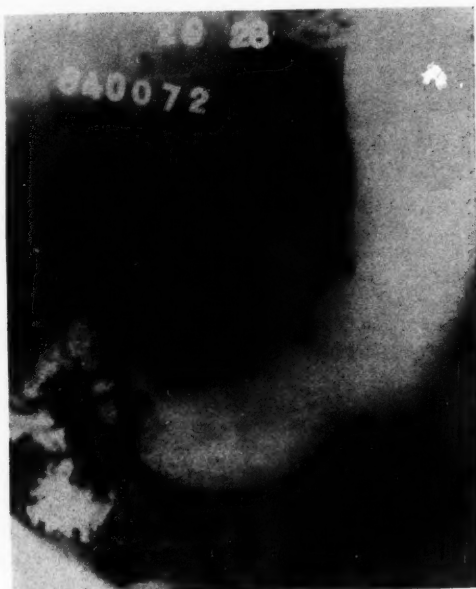


Fig. 3. Spastic bulb with sharply defined borders resembling the deformity often seen in duodenal ulcer. At operation a diffuse duodenitis, but no true ulcer, was found.

ulcer are sometimes associated and signs of both would necessarily be commingled. It would seem that the presence of duodenitis is to be surmised when the bulb is contracted, greatly deformed, not sharply delineated, empties quickly, and has a tendency to change slightly in aspect from moment to moment. The surmise is strengthened if neither marginal niche nor central fleck can be discerned, and if a residue from the six-hour meal does not remain in the stomach. Yet this complex of signs is not essentially different from that resulting from a reflexly irritable bulb, such irritability often being associated with disease of the gall bladder. It differs in degree in that the reflexly irritable bulb is likely to change more rapidly in contour and assume a normal outline more frequently. But mere differences in degree are seldom safe indexes in diagnosis. It is possible that often what is



Fig. 4. Fairly normal appearing duodenum with some spastic manifestations and a rather hazy contour; diffuse duodenitis at operation.

assumed to be reflex spastic deformity of the bulb is really a manifestation of duodenitis, and that any bulb which is reluctant to take on a normal outline is open to suspicion. It is my opinion that the bulbar irritability suggesting the diagnosis of duodenitis is best recognized during the period of emptying. In such cases the bulb does not empty in a normal even manner, but a spastic, irregular, skeleton-like cap is seen during this period, although it may appear normal during the filling phase and while the duodenum is completely filled.

In view of the fact that duodenitis as an entity is a comparatively recent observation and because this series of cases is relatively small I do not feel justified in assuming that all cases of duodenitis can at present be recognized roentgenologically as such. However, even though this study does not

give positive data for this recognition I hope that it may stimulate careful investigation of the irritable duodenal bulb as herein described and lead to a correlation of the roentgenologic, surgical, and pathologic data with a view to improving the accuracy of the diagnosis (Figs. 1 to 4).

SUMMARY

In 1921 Judd directed attention to duodenitis, inflammation of the duodenal mucosa with or without actual ulceration. His observations have been corroborated from the histopathologic standpoint by MacCarty, Konjetzny, and Wellbrock. The present study of its roentgenologic manifestations is based on forty-five consecutive cases, without ulceration, observed in recent months at The Mayo Clinic. This series indicates that duodenitis is characterized roentgenologically by marked irritability of the bulb which tends to empty itself quickly but incompletely. As a rule, the bulb is small and grossly deformed by deep indentations, and its borders are less sharply defined than in cases of true ulcer. It differs also from typical ulcer in that a marginal niche or central fleck cannot be seen and does not cause gastric retention. Its positive distinction from frank ulcer is not yet feasible and it might be confounded with reflex spasm of the bulb, but it seems to warrant further study.

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The Radium Therapy of Basedow's Disease. F. Gudzent. *Strahlentherapie*, 1928, XXX, 634.

According to Holz knecht, 60 per cent of the cases of Basedow's disease are cured by roentgen therapy, while another 20 to 30 per cent are without doubt improved. Whether exposure of the thymus has any influence on the course of the disease is not definitely known. Filtered radiation should be used in doses of one-fourth to one-sixth E.D. In severe cases smaller doses are indicated. Only those patients should be operated on who do not respond to roentgen rays. Cases with a large struma, compression of the trachea, or very acute cases of Basedow's disease do not respond favorably to radiation. Following moderate doses there are no adhesions formed to render a future operation difficult.

Schwarz discusses, first, all symptoms of the true Basedow's disease as compiled by Mayo. He advises against iodine medication combined with X-ray therapy, both in the toxic adenoma

and in the true Basedow's disease. According to him, the thymic region should be included in the field, while the larynx and the trachea have to be carefully protected. In consideration of the psychology of patients suffering with this disease, roentgen therapy should always be given a trial.

Pordes summarizes his standpoint as follows: All thyroid toxicoses respond to X-ray therapy; one particular type is characterized by sub-febrile temperatures, loss of weight, fatigue, and can easily be mistaken for tuberculosis of the lungs. Quite often X-ray therapy of the thyroid leads here to a complete cure. Very small doses of roentgen rays are advised. They are to be given at long intervals and all cases have to be kept under strict control.

Gudzent prefers radium in the treatment of Basedow's disease. He uses 100 milligrams of radium element in six tubes two centimeters in length, in 1.5 brass, which are fastened to cork or rubber plaques one centimeter in thickness. The skin over the thyroid is covered by a thin layer of cotton. Seventy-five per cent E.D., corresponding to 24 hours' exposure, are given as a rule. Sometimes this has to be repeated after ten weeks. His results lead to the conclusion that radiation therapy of Basedow's disease is the method of choice.

E. A. POHLE, M.D., PH.D.

A ROENTGENOLOGIC STUDY OF THE CHILD'S CHEST¹

By P. R. CASELLAS, M.D., CHICAGO

GENERALLY speaking, roentgenology in childhood is as dependent on clinical evidence as pediatrics is on the mother of the little patient. Just as the mother furnishes to the pediatrician the history of the case as well as part of the subjective symptomatology, the referring physician makes an intelligent examination possible, at times, only by giving to the roentgenologist full information about the case. Autopsy studies have increased our knowledge of intrathoracic pathology to such an extent that the interpretation of roentgen shadows in the adult's chest is not usually an enigma. The child's chest, however, is not so clearly understood, not only because we lack sufficient autopsy data but because the information derived from the mother or from the little patient is most often inaccurate and misleading.

Roentgenology of the child's chest differs in a great measure from that of the adult, where we have rational patients who can follow directions. In children, the time of exposure must be so rapid as to overcome any movement and this so-called "flash technic" requires a careful study of the patient's thickness and the contexture of the extra-thoracic tissues to determine the degree of penetration of the X-ray beam necessary to produce a diagnostic radiograph. In roentgenology, certainly, the prime consideration is not photographic beauty but to show a pathologic condition as it exists.

Chest radiography in children varies greatly with the condition to be studied. To diagnose radiologically an enlargement of the thymus from a single film is as unscientific as to deny a possible fracture of a shoulder without stereoscopic study. If my

personal experience is a guide, I would say that in 90 per cent of the babies brought for X-ray examination of the chest, suspected thymic enlargement is the cause for examination. The peculiar choking, crowing breathing and the inability to swallow without lowering the head are typical of mediastinal pressure, but not always can they be ascribed to thymic tumefaction. The radiologic findings, however, very often solve the problem. I make three exposures, one in the upright position, one in the prone, with the little patient quiet, and the third in the same position while the patient is crying—all flashed at the end of expiration. A frankly enlarged thymus will register in all three positions.

The shadow cast by a pathologic thymus is rather characteristic, if the proper penetration has been used. It is less dense than the one seen in cases of mediastinal adenitis; it usually projects from both sides of the median shadow (though it may be unilateral); its borders are clean-cut and convex, and its widest point is where it merges with the heart shadow. Then, too—and a very important finding—the shadow widens considerably from the film taken in the upright position to that taken in the prone position with the patient crying. A lateral view is imperative in order to investigate the posterior group of mediastinal glands, for often we find a little patient with a thymic syndrome brought about by a marked enlargement of these glands exerting pressure over a flexible trachea. Substernal thyroids, occasionally met with in childhood, cast a shadow the width of which increases from below upwards and does not increase in volume when the child cries. The lymphosarcomata are *par excellence* the malignant mediastinal tumors of children.

¹Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3-7, 1926.

Except the thymomata, that originate in the thymus, they develop from the mediastinal and tracheobronchial nodes, so that the location of their shadow conforms to their origin. They may be so situated as to cause pressure symptoms, but they grow so rapidly that the progressive symptomatology and the changes observed in serial roentgenography leave no doubt as to the diagnosis. Subacute mediastinal adenitis is shown on the radiograph as dense bilateral shadows, with irregular concave borders, found—invariably by means of lateral radiography—in the posterior mediastinum. It is well understood that a diagnosis of tuberculous mediastinal adenitis cannot and should not be made from the X-ray findings alone, for other respiratory infections may give rise to mediastinal glandular hyperplasia, yet when this hyperplasia registers on a chest film of a child pale and droopy and undernourished, or with a history of progressive loss of weight and of having run an irregular fever, we can chance—with a fair degree of certainty—a diagnosis of mediastinal glandular tuberculosis.

Acute mediastinitis has been shown by the X-ray to occur much more frequently than was formerly supposed, when its recognition was wholly clinical, although the phlegmonous type cannot be recognized radiographically unless it becomes localized. It may be of primary origin when resulting from injury to the esophagus by the swallowing of a foreign body, or from injury following instrumental manipulation, also as a complication in infectious pneumonia. These were the causative factors in two cases observed by the writer. A boy, eight years old, swallowed a lead toy automobile 1×3 centimeters in diameter. The removal was followed by copious hemorrhage, shown by melena. Ten days later the child developed a septic temperature, complained of pain between the shoulders, and had marked arrhythmia. Because of the pro-

nounced hoarseness the case was diagnosed as acute laryngitis, but this diagnosis was quickly discarded when radiography of the chest showed a well demarcated area of hyperdensity, projecting from the median shadow into the left side, overlapping the structures of the hilum. The blood count showed a high polynuclear leukocytosis, the hoarseness and arrhythmia being due to compression of the recurrent laryngeal and vagus nerves.

The disease must be differentiated from acute mediastinal adenitis, which is usually sequela to an acute respiratory infection such as influenza and the pneumonias. The X-ray findings are rather typical, one of the shadows of the hilum seeming greatly increased in size and so dense as to have a consolidated appearance. If the disease reaches the terminal stage, breaking down of the glandular structures takes place, with subsequent abscess formation. These mediastinal abscesses are demonstrated radiographically in the form of a triangular dense shadow directly behind the heart, with the base close to the diaphragm and the apex at a level with the region of the hilum.

Apical lung abscesses in the adult are said to be of metastatic origin, while those at the bases usually result from the inspiration of infectious material. These facts, however, according to my observation, do not appear to hold true in childhood. The greater percentage of pulmonary abscesses in children that can be attributed to inhalation of infectious products have occurred at the apices. This can be explained theoretically if one considers the fact that practically all operations in the upper air passages in children are done with the patient in the prone position. Also, the younger the child the greater the number of hours that are spent in the recumbent position.

While in the adult, primary carcinoma in the parenchyma, localized empyema, unresolved pneumonia, indurative tuberculosis,

and pulmonary sclerosis may give X-ray findings identical with pulmonary abscess, in children we have only two pathologic processes that may be mistaken for pulmonary abscess, unresolved pneumonia, and atelectasis following bronchial obstruction. If the obstructing object is opaque to radiation, the shadow interpretation is easy, but when the foreign body is radioparent we may be confronted with a most difficult differential diagnostic problem. A negative history is of no importance, because children frequently swallow or inhale foreign bodies without parental knowledge. Another misleading factor, the retained secretions in the atelectatic area may decompose and produce the blood changes accompanying pulmonary abscess, and, too, fever may be associated with either of these conditions. Pulmonary gangrene at times is very difficult to differentiate clinically from pulmonary abscess, though the differentiation is most important on account of the prognosis. In most instances the X-ray furnishes conclusive evidence. The pathology is quite definite: first stage, mortification, the moistness and firmness of the tissues, intercepting radiation, casts a localized hyperdense shadow; second stage, beginning disintegration, radiographically shown by areas of rarefaction within the hyperdense shadow, and, finally, the third stage, frank necrosis, giving X-ray evidence of cavity formation.

Bronchopneumonia and lobar pneumonia give such characteristic X-ray appearances that their detection in conjunction with the clinical symptomatology does not require great acumen. Pneumonia cases, however, should be radiographed, not only to determine the degree of involvement, but certainly to discover early complicating features such as empyema and abscess formation.

Parenchymatous tuberculosis of the lungs of primary origin in infants is not recorded. The disease is always secondary to mediastinal glandular infection, so that

in addition to the changes previously described, fan-like shadows, with the base toward the periphery, are seen radiating into the pulmonary field from the region of the hilum, most frequently into the upper lobes. All the cases that have been observed by me have been unilateral. The condition must be differentiated from apical pneumonia, in which case only the group of glands on the affected side show hyperplastic changes. Of course, if a case of tuberculosis of the hilum is complicated with apical pneumonia, serial roentgenography will show changes in the density of the pneumonic area from day to day.

Miliary tuberculosis in children is not uncommon. Whether or not the pulmonary infection is primary has not been established, because postmortem findings show the tubercles in miliary formation elsewhere. Certainly, in some cases the infection involves every organ. In one of my cases even the heart muscle showed miliary infiltration. The tubercles in myriads are reproduced on the X-ray film as hyperdense areas surrounded by a fine, blurred, less dense ring which is cast by exudative material. Pulmonary gummatous parenchymal infiltration may have a miliary distribution, but the shadows are larger and the blurred ring is missing, due to lack of exudative reaction around the individual gumma.

The dyspnea and polypnea accompanying pleural effusion in childhood is mechanical. The great flexibility of the mediastinal structure makes for easy displacement and torsion of the air passages, with subsequent diminution of the pulmonary surface area, sometimes by a relatively small amount of effusion. Serous pleurisy is easily recognized in the child's chest by the uniformity of the triangular dense shadow covering the base of the lungs, with the apex of the triangle pointing toward the axilla. Encapsulated effusions, however, must be differ-

entiated from consolidation, and here, again, serial roentgenography comes to our rescue. Fibrous pleurisy *per se* is a rarity in infancy. In the majority of instances we must depend on clinical evidence in order to differentiate between effusion and purulent, acute empyema, but when this is of a chronic variety the association of inflammatory hyperplastic changes in the pleural layers furnishes variation in X-ray density that usually permits differentiation. Empyema necessitatis, when freely draining, gives no typical intrathoracic X-ray findings, so that the injection of the fistulous tract with an opaque material will furnish the only means to differentiate it radiographically from rib abscess.

Localized pulmonary fibrosis of unknown etiology is a pathologic entity in childhood. Reisman calls it a "lobar form of bronchopneumonia," and considers it due to the Pneumococcus. The X-ray appearance is identical with that of the interstitial pneumonitis found in the adult. In other words, there is a localized hyperplasia of the pulmonary stroma, shown on the film by well-defined mossy marking in reticular formation, corresponding to the terminal bronchioles, normally not demonstrable by the X-ray in the living subject. Similar changes are occasionally met with in congenital pulmonary syphilis. They must be clinically differentiated.

It has been my experience that the X-ray is of very little assistance to the clinician in cardiac affections of childhood, it being of real value only in establishing the presence of pericardial effusion, which is differentiated from congenital heart by the shifting of the fluid shadow. In young babies this differentiation is most difficult at times.

I have made no attempt to cover all the X-ray pathology of the child's chest, which would require much more than the time allotted. I have limited this paper to a very succinct exposition of the most frequent or

perplexing problems, in the solution of which radiology plays an important rôle.

DISCUSSION

DR. W. W. WASSON (Denver): Dr. Casellas' paper is one of the very few papers on this program on children. There is no better place to study pathology than in the child. The pathology is pure, uncomplicated by years of life, and in place of one or two papers we should have many papers illustrating observations from various districts in the study of the child. I firmly believe that we cannot know anything about adult pathology if we do not know the pathology of the young child. Dr. Waring, in Denver, has examined a series of babies from birth to six and seven years of age (that is, the same child in sequence), along with radiographic films and other laboratory studies, and his conclusions are that he can tell very little if anything from physical examination of an infant's chest. Certainly the infant, or young child, cannot tell us of his symptoms, so that the radiographs have filled in a great gap and made it possible to study the infant and the young child.

The thymus has been studied a great deal since the time of Galen, and it has been quite popular to treat the enlarged thymus. When the baby with the stridor is brought to the pediatrician he immediately has a radiograph made of the chest, and if the child is well nourished and is under one year of age, he is very apt to find an enlarged thymus. It is immediately assumed that the thymus is the cause of the stridor. If further examinations are made, if a larger series of cases are studied, if a radiograph is taken of the sinuses, it will be found that a large percentage of these cases of so-called thymic stridor have sinus infection. Now we have been taught that infants do not have

sinus infection, that they do not have susceptible sinuses. I brought along a few films and placed them on exhibit to illustrate the tremendous amount of infection that we do find in sinuses in young infants. Frequently we have the coincidence of a sinus infection with mucus in the trachea and bronchi, producing a stridor and the large thymus. Treatment of the thymus may be helpful. Just why may be difficult to answer, but perhaps from the action of the rays upon the mucous membranes of the bronchi. Such a coincidence should not deter us from making an examination of the sinuses and getting at the source of infection, and if those cases are treated for the sinus infection they nearly all recover.

DR. H. K. PANCOAST (Philadelphia): This paper should not go by without some favorable comment, as it has been a very valuable contribution. I certainly hope that the individuals who are working on the problems of experimental injections of lipiodol and other oils will take up the study of their effects upon lung structure, because it is very necessary for us to know just how much damage can be done to the lung structure by the use of iodized oil injections. There can be no question but that some damage can occur. This presentation should be a warning to us to observe a little more care in the use of iodized oil in the study of lung pathology. The first examination made of a case before the oil is used will usually determine exactly where the injection is needed, and then, instead of indiscriminately pouring the oil down the respiratory tract, it should be placed in the proper position, in just as small a quantity as is absolutely necessary for the purpose of diagnosis. Still further, after making the necessary examinations with the oil, if very much oil has been needed, certainly as much of it as is possible should be removed by a

subsequent bronchoscopy. Any one of you who has examined lungs a week, a month, or longer after the injection of iodized oil, will realize the necessity for the use of as little of it as possible.

Thymus examinations in children occur almost as frequently as any other examination at the present time, because of the popularity of the so-called large thymus. Any child will have an apparently large thymus if examined in one view only, especially if that one examination is made only during expiration. We feel that the exact diagnosis of enlarged thymus must depend upon the lateral view of the child's chest, by observing the space between the sternum and the trachea and the amount of compression of the trachea as determined during the two phases of expiration and inspiration. During inspiration you may see the trachea wide open, and during expiration you may find it much compressed. We have come to depend much more upon the lateral view in the diagnosis of enlarged thymus than we do upon the anteroposterior view.

It may not be germane to the subject to refer to enlarged thymus or persistent thymus in adults, but in a clinic where a large number of goiter cases are treated, it is customary now to examine all such patients for substernal thyroids, for the possibility of persistent thymus, and also for any lung condition which may be present—as is frequently the case. Up until about two years ago, we not infrequently diagnosed a persistent thymus in adults. Many of these patients were given pre-operative irradiation, until one day we diagnosed an undoubted thymus and the next day the patient died from some cause not pertaining to the thymus, and at autopsy no vestige of thymus remained. That individual had no thymus whatever. Then we searched for a cause of the shadow we had been finding in so many instances, and finally decided that that shad-

ow which we had been mistaking for thymus was a shadow of the superior vena cava, still further prolonged upward by the

innominate. Since that time we have not diagnosed a single enlarged or persistent thymus in an adult.

The Roentgen-ray Treatment of Tuberculosis of the Eye. G. Herrnheiser and G. Braun. *Strahlentherapie*, 1928, XXVIII, 770.

In treating tuberculosis of the eye by roentgen ray, small doses are advisable. The authors recommend 120 K.V., 8 ma., 4 millimeters aluminum, 30 cm. F.S.D., 4×4 cm. field. A single dose corresponds to 50 to 70 R (measured in air) or 1-2 H on the surface of the bulbus. Four applications at one-week intervals represent a series. Sometimes further treatment is necessary; this can be administered four to five weeks after the first series. Tuberculosis of the anterior part of the bulbus showed favorable results, as has been reported by a number of investigators. The authors succeeded also in improving nine cases of tuberculous choroiditis. Some recent experience with higher filtered radiation as used in

deep therapy has not led to definite conclusions.

E. A. POHLE, M.D.

The Roentgen-ray Treatment of Genital Tuberculosis in the Male. J. Palugyay. *Strahlentherapie*, 1928, XXVIII, 762.

X-ray therapy is considered as an important factor in the conservative treatment of genital tuberculosis in the male. It is best to administer small doses (5-10 per cent S.U.D. in the diseased area). This dose can be repeated every 7 to 10 days. It is necessary to include the entire genital tract in the field of exposure. After three years of observation, clinical cure was observed in 30 per cent of the cases and improvement in 50 per cent of the twenty-six treated cases.

E. A. POHLE, M.D.

METHOD OF GRAPHICALLY EVALUATING PHOTOGRAPHIC SPECTRA¹

By A. MUTSCHELLER, PH.D., NEW YORK

THE practical value of the photographic X-ray spectrum depends to a large extent upon the convenience and dependability of the methods available for estimating the intensity of the various wave lengths of the spectrum as they are represented by the blackening on the film. A logical method would be to estimate photometrically the blackening of the film and in

when using this sort of microphotometric method, it appears justifiable to describe a method which does not require the use of a microphotometer and which also avoids some of the errors which are usually made in the use of microphotometers.

A photometric method of measuring the intensities of X-ray spectra was described by Glocker and Kaupp (1) and a critical study was made by them of the conditions under which the minimum wave length, in particular, can be quite accurately determined from photographic spectra. Such spectra, however, are usually made with intensifying screens; but, as is well known, the characteristic properties of the screens and of the photographic materials are bound to introduce errors which cause the photometered spectrum to differ considerably from its true and actual outline.

The present writer has, therefore, concluded that if the photometric estimation of the blackening of a photographic spectrum is made by comparing it with a photographic scale prepared under conditions similar to those of the spectrum, then the larger part of such errors are compensated for (2). Attempts in this direction (3) have proved successful and the necessity of employing a microphotometer is thereby avoided because a microscope and a simple additional device fulfill its purpose.

The photographic scale above referred to is prepared by withdrawing from underneath a lead cover a film of the kind employed in making the spectrogram, which is being held between the same two intensifying screens that are employed in the spectrograph, while the entire mechanism is exposed to X-ray radiation. The film is then developed and finished in exactly the same solutions and by the same process as the

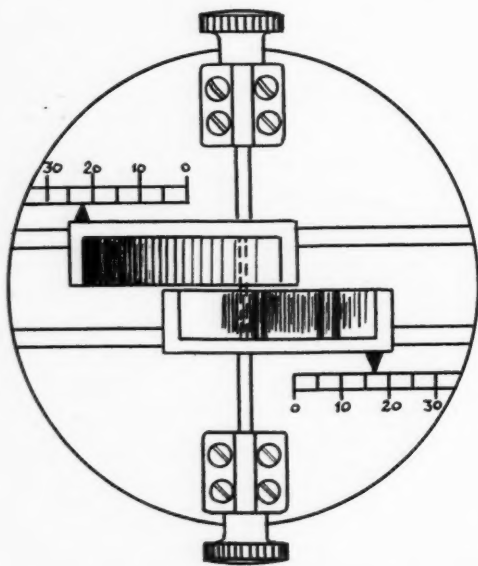


Fig. 1. Top view of the microscopic attachment. On the left slide is the photographic scale, on the right slide the spectrogram.

that way a curve would be obtained, that is an approximate measure of the relative intensities of the various wave lengths. Because of the fact that the microphotometer required for this purpose is costly and, therefore, not always available, and also because of certain errors which may be made

¹Received for publication March 17, 1928.

photographic spectrum. The exposure of the scale is easiest made with the aid of a Bucky Diaphragm. The film located in a cassette between the two intensifying screens is placed upon the moving part of the diaphragm; over it is supported a lead plate in such a way that the cassette moves with uniform velocity out from underneath the stationary lead plate. A motion of about 5 cms. is usually sufficient, while an exposure of 2 seconds is made at a distance of 2 meters with 2 ma. and 200 K.V. through 0.5 mm. copper. If, then, this film is developed in exactly the same manner in which a spectrogram made with a Seemann spectrograph is developed, the correct density will be obtained.

While not all the possible errors in the intensity distribution of the spectrum are eliminated by this method, it is quite obvious that the characteristic properties of the photographic material and the errors which otherwise would be introduced due to these characteristics are, through matching tints of the spectrogram with a scale so prepared, to a large extent compensated for.

The device required, in addition to a microscope, is illustrated in Figures 1 and 2. It is easily made by a skilled mechanic. It consists of a perforated metal plate, upon which are two parallel moving slides which can be actuated by a rack and pinion device. Upon one of these slides is fastened the scale and upon the other the photographic spectrogram in such a way that they lie close together. On the base plate there are two millimeter scales and each one of the slides carries a pointer so that the displacement of the film mounted upon each respective slide is indicated in millimeters on the scale. There is also provided a slot, about 0.75 mm. wide, running over both films crosswise to the direction of their travel, so that narrow strips of both films lie side by side and are equally illuminated through the same slot.

The process of photometering the spectrograms is carried out as follows. Both films are mounted, one on each slide of the microscopic attachment. The spectrogram is then moved until the clearest part of the film

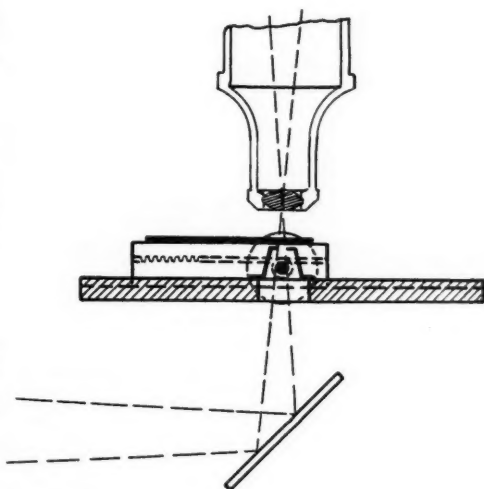


Fig. 2. Side view of the microscopic attachment which is placed upon the table of the microscope.

lies over the slot. With low power magnification (about 8 to 15 diameters) the illumination of the microscope is adjusted to normal intensity and the slide, with the scale, is displaced until the tints on both fields are equal. Readings are taken on both millimeter scales except that the spectrogram, after every reading, is displaced exactly $\frac{1}{2}$ mm., whereas the scale is always adjusted to equal intensity or shade and the positions of the two pointers on the millimeter scales are recorded. The equal displacements along the spectrogram are then plotted along the horizontal axis and the pointer readings of the scale are plotted along the vertical axis of regular cross-section paper.

The photographic spectrograms should be fully exposed and developed, yet they should not be so dark that the double characteristic

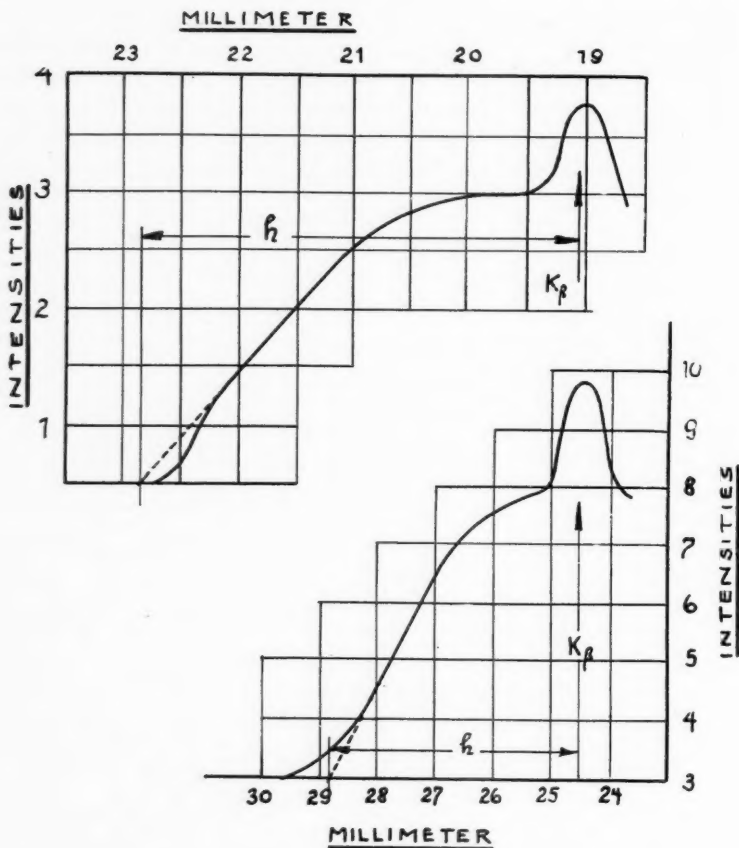


Fig. 3. The upper curve shows how overexposure and the use of an old developer may shorten the minimum wave length darkening. The lower curve, on the other hand, shows how a fresh developer and forcing in the developer may prolong that shadow. In both cases, however, the tangent, as indicated by the broken line, gives the true minimum wave length.

K_β lines are no longer clearly distinguishable.

Because of the fact that the K_β lines are clearly visible in the first and second order, it is simple to measure the distance between the K_β lines of the first and the second order. The distance between these corresponds to .1843 Ångstrom unit. Because of the fact that the sine of a small angle is practically equal to the angle itself, it is permissible to consider each millimeter of the spectrum in Ångstrom units equal to

.1843 divided by the distance in millimeters between the K_β lines of the first and the second order. If, then, the number of millimeters is determined from the K_β line of the first order lines to the point where a tangent to the slope of the curve crosses the zero axis, this distance is multiplied by the ratio above found and its value is subtracted from .1843, the result obtained being the minimum wave length in Ångstrom units. By dividing 12.3 by this minimum wave length in Ångstrom units the kilo-

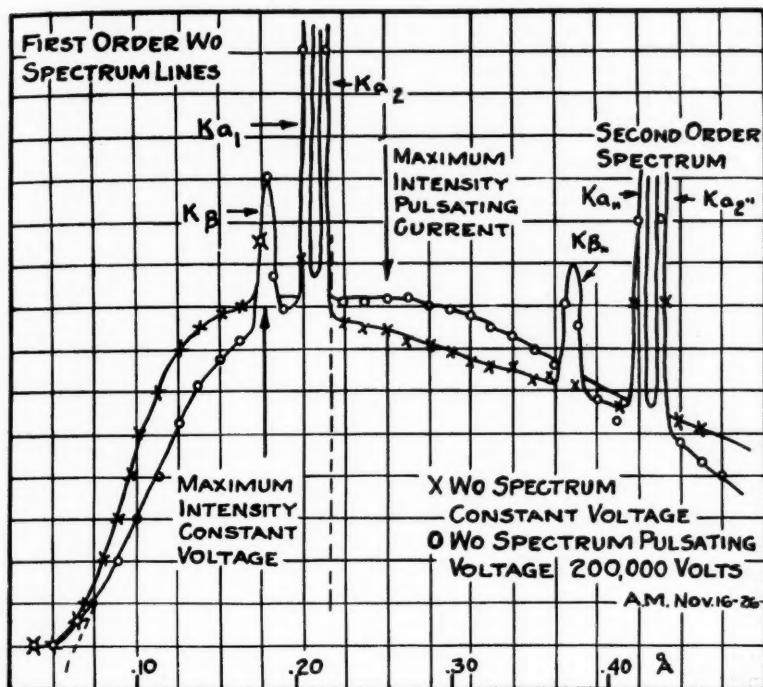


Fig. 4. Spectra made at about 240 K.V. mechanically rectified current and 200 K.V. constant voltage current. Both show the same minimum wave length.

volts are obtained, which are applied across the electrodes of the X-ray tube with which the spectrum was made.

As pointed out by Glocker and Kaupp (4), there may be differences in the end point of the spectrum representing the minimum wave length. These differences may be due to the composition of the X-ray beam or to the photographic technic. It has been determined, however, that the slope of the curve, if extrapolated down to the zero axis, is the true indication of the minimum wave length. For that reason the distance should be measured—not between the actual intersection of the photometered curve with the zero axis and the $K\beta$ line, but between the latter and the tangent of the spectrum curve, as is indicated in Figure 3.

Figure 4 shows the spectra of two radia-

tions produced under like conditions with the same X-ray tube, but one with mechanically rectified and the other with constant potential current. This example shows how this comparatively simple method may give results which are fully as useful as those obtained by the more elaborate ionization method. But there can be no doubt that for the determination of the minimum wave length or exact voltage applied across the electrodes of the X-ray tube, especially if high tension voltages on different equipments and current curves are to be compared, this method gives much more accurate and true results than the now so much employed devices, as spark gaps, electrostatic voltmeters, etc.

While this method is primarily intended and developed for the exact determination

of the minimum wave length and the voltage applied across the electrodes of the X-ray tube, it is self-compensating against gross errors to such an extent that in many instances it may be applied instead of the complicated and cumbersome ionization

method employed for determining the intensity distribution of X-ray spectra.

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- (2) See also KIRKPATRICK: *Phys. Rev.*, 1923, XX, 37.
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- (4) *Loc. cit.*

Comparison of the Absolute R-unit with the French R-unit. H. Walch, D. den Hoed and L. J. Koopman. *Strahlentherapie*, 1928, XXIX, 524.

A comparison of the *R*-unit as laid down in the Solomon Ionometer was made with the *R*-unit as defined by Behnken. A large ionization chamber which had been checked in the Bureau of Standards in Berlin was used in the comparative measurements. It appears that the Solomon instrument shows considerable independence of the wave length. The relation between French and German *R*-units changes also with changing wave length. This is in agreement with the publication of Murdoch and Stahel. The authors also found that different Solomon instruments of the same make lead to different results. They conclude,

therefore, that this particular instrument can not be chosen as standard.

E. A. POHLE, M.D., PH.D.

The Biological Importance of Red and Quartz Light Radiations. Fritz Ludwig and Julius von Ries. *Strahlentherapie*, 1928, XXIX, 581.

In experiments on plants and animals, the authors demonstrate the fact that ultra-violet radiation activates the D vitamins. It is possible to invalidate this activation by following exposure to red rays. On the other hand, it is also possible to reactivate the D vitamin which had been rendered ineffective under red radiation by exposing it to ultra-violet rays.

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CLINICAL AND EXPERIMENTAL STUDIES OF LOW DOSAGE IRRADIATION OF THE OVARIES AND HYPOPHYSIS IN MENSTRUAL DISORDERS¹

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CERTAIN cases of menstrual disorders including habitual amenorrhea, oligomenorrhea, menorrhagia, metrorrhagia and dysmenorrhea, all as a rule associated with sterility, may be favorably influenced by irradiation of the ovaries or hypophysis with relatively small amounts of roentgen rays. Several facts can be established only by wide experience and careful subsequent tracing of each patient treated. These matters which need further investigation are as follows: the exact indication for radiotherapy in preference to other therapeutic agents, the most favorable factors in treatment, the consistence and duration of the relief afforded, and the likelihood or improbability of sequelæ dangerous to the patient or her offspring. It is to add to such information that we are reporting our experiences in this field.

There is, we believe, little comprehension of the amount of physical suffering and economic incapacity occasioned by severe degrees of menstrual irregularity. Whenever such a disturbance can be attributed to general systemic alteration or disease, or to local pelvic abnormality, therapeutic measures obviously should be directed to the correction of the causal factors. In a considerable group of patients, however, there is extreme menstrual irregularity from puberty, and physical examinations and history are negative in all significant respects. For these, essential ovarian dysfunction or hypofunction must be postulated. These cases must be chosen with care, for nothing would be more certain to bring radiotherapy into dis-

repute than the indiscriminate application of irradiation of low dosage in all menstrual disorders.

The belief that the same etiology may be assumed to underlie such diverse manifestations of menstrual aberration as the extreme cases of menorrhagia, on the one hand, and, on the other, pronounced oligomenorrhea or habitual amenorrhea, is supported by the interrelationship of the various types of disorders and the similarity of associated symptoms. The outstanding feature of all cases in the group is complete lack of menstrual rhythm. Severe dysmenorrhea is an almost constant accompaniment of oligomenorrhea and also of extreme menorrhagia. The most pronounced metrorrhagic tendency may cease abruptly, to be replaced by long periods of amenorrhea, and this by a subsequent spontaneous return to the earlier manifestations. Sterility, associated with the various types of ovarian dysfunction, frequently is of prime importance from the patient's point of view and is her chief motive in seeking relief. Pelvic examination in such cases frequently reveals a relatively small uterus and slightly enlarged cystic ovaries, which apparently contain small cysts. According to our criteria, the degree of pelvic change in the cases included is within the range of data compatible with normal menstruation and reproduction in other individuals.

Certain secondary symptoms are of importance in the recognition of this group and perhaps of significance in prognosis of the probable response to treatment. Among those with amenorrhea, extreme obesity is common; it was present in twelve of six-

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teen cases in our group. The rapid gain in weight usually follows a considerable period of suppression of menstruation. Moliminal manifestations, often of severe degree, may occur cyclically throughout the period of amenorrhea or may be superimposed on almost continuous metrorrhagia. Vascular phenomena, such as hot flashes and profuse sweating, are common in cases in which the disturbance has been prolonged and severe. Headaches are frequent, and apparently depend on the severity and prolongation of menstrual aberration. Patients with amenorrhea especially seem prone to mental depression and to introspection, which may give rise to all manner of neurotic manifestations. The patients with menorrhagia and metrorrhagia are less subject to psychic change, but experience more actual physical incapacity because prolonged rest in bed is often imperative. An extremely low hemoglobin level occasionally is found, although as a rule secondary anemia develops more slowly in these patients than in patients who have hemorrhage of extragenital origin. Many of the patients, because of continued hemorrhage or weakness, are handicapped in school duties or occupation. The same physical and economic disability accompanies severe dysmenorrhea. In dysmenorrhea due to ovarian dysfunction a prodromal period of several days to one week, marked by depression, fatigue, abdominal pain, or backache, usually precedes the onset of menstruation. In distinction from the obstructive types of dysmenorrhea, the most intense pain arises as the flow becomes freely established, and it may continue throughout the period. The accompanying nausea and vomiting usually prevent oral medication. Opiates are required in many cases. Syncopal attacks frequently occur. The pain may be of such duration and intensity that the patient scarcely recovers from the ensuing state of exhaustion before the cycle is repeated.

Relief can be afforded in a certain proportion of the disorders by long-continued administration of commercial ovarian extracts; these occasionally are made more effective by the supplementary use of thyroid or pituitary extracts, by a high vitamin diet and by appropriate rest or exercise. The factor of expense associated with the extensive use of the glandular compounds is often important to the patients. A large percentage of patients seem to resist any variety or combination of extracts now on the market. It is particularly in these cases in which a thorough trial of glandular therapy has failed to re-establish menstruation, that irradiation of the ovaries or hypophysis seems indicated. This fact necessarily limits treatment to the more severe cases, and the results of the two methods are not strictly comparable. It remains for further experience to establish whether, from the point of view of convenience to the patient, radiotherapy, if reasonably indicative of a continued favorable result, will be preferable to the prolonged intensive glandular therapy now in vogue.

A consideration of the mechanism by which small amounts of roentgen rays, acting either on the ovaries or on the hypophysis, are able to re-establish cyclic menstruation and to relieve sterility would serve only to open theoretic controversy. Discussion of the question of possible germ injury through ovarian irradiation also would serve no purpose. The harmlessness of irradiation of the ovaries in low dosage seems to us sufficiently well established by all pertinent biologic studies and by the numerous instances of normal children being born to women who previously had been irradiated with even much heavier doses than those required in the treatment under consideration. Furthermore, we believe that there has been no direct clinical evidence of hereditary injury occasioned by irradiation. Many roentgenologists claim that any pelvic irradiation

short of the full castration dose is entirely unnecessary, since the same good results in the regulation of menstruation can be obtained by irradiating the pituitary gland alone. Early and perhaps too brief experience in the treatment of amenorrhea has given us the impression that irradiation of the ovaries in the dosage we have employed has been more certain of re-establishing menstruation. We, therefore, have chosen it in the treatment of patients who live at a considerable distance, for whom subsequent treatment would be difficult or impossible. Usually the patients, and often the physicians who refer them to us, are more apprehensive of pituitary than of ovarian irradiation. We are confident that there is ample evidence in the innumerable cases in which there has been irradiation of the pituitary gland incident to the treatment of orbital disease or of cranial lesions entirely to disprove the contention that irradiation will initiate or aggravate the symptoms of a pituitary disorder.

Technic.—We have applied to each of two abdominal or cranial fields 10 to 15 per cent of a unit skin dose (H.E.D.). The rays have been generated at 200 kilovolts peak tension and have been filtered through 0.75 mm. of copper and 2 mm. of aluminium. The estimation of the dose reaching the ovaries or hypophysis has been based on penetration studies for rays of similar hardness, average cross-section body areas being used to determine the level of the organ involved. Alteration in time of exposure is made roughly in proportion to the thickness of the abdominal wall or the size or shape of the head. With such technic the effective dose at the ovary or hypophysis is equal to or below 10 per cent of a unit skin dose. Two cases in our series have been treated with moderate voltage rays, produced by 135 kilovolts peak tension and filtered through 4 mm. of aluminium. This treatment, in these two cases, was applied to

two small suprapubic fields. Both patients have failed to respond to treatment. We would not condemn the possible effectiveness of this technic, however, from such limited experience. The optimal dose and type of irradiation are still to be determined and may be found to vary with the severity of symptoms. Our dosage is slightly lower than that employed by Kaplan, whose recent report shows a higher percentage of cases in which menstruation was restored and in which pregnancy occurred subsequent to treatment than we have attained in our cases. The difference in results may be due to the fact that only the most resistant cases of menstrual disorders were selected for irradiation in our series.

Clinical Results.—The results of irradiation in cases of amenorrhea are shown in Table I. Fifteen of eighteen cases received irradiation of the ovaries. In nine instances menstruation followed treatment within six weeks. It ceased after the first period in two cases; it continued regularly for periods of four months or longer in six cases; one patient has not replied to questionnaires. One application of irradiation to the ovaries was made three months after unsuccessful irradiation of the pituitary gland. In one case in which the first irradiation to the ovary had resulted in an initial but scanty flow, combined pituitary and ovarian treatment was given during the following month; the ensuing three periods have been regular, free from pain, and the flow has been increasingly profuse. Moliminal symptoms were produced in two cases without the establishment of menstruation. Marked improvement in health is reported by six patients, two of whom have not experienced re-establishment of menses. As a result of irradiation of the pituitary gland in four cases, initial menstruation occurred in only one case; her menstruation has occurred regularly in the five months since the treatment was given. Definite molimen oc-

TABLE I, RESULTS OF IRRADIATION IN CASES OF AMENORRHEA

Case	Age, years	Weight, pounds	Frequency of periods of amenorrhea	Organs irradiated	Initial menstruation within 6 weeks	Duration of regularity of menstruation	Production of cyclic molimen	Improvement in general health	Period of observation
1	24	118	11 months	Ovaries	+	1 year		+	2 months
2	24	240	6 months; usually menstruates twice a year	Ovaries	+	4 months; irregular for 3 months			Intercurrent illness after 1 year
3	22	201	18 months	Ovaries	+	4 regular periods; flow increasing in amount		+	9 months
4	22	Overweight	2 years	Pituitary and ovaries	+	6 months; then became pregnant; 3 months after delivery; then pregnant		+	3 months
5	32	213	2 years	Ovaries	+	4 months; then the previous irregularity			1 year 11 months
6	24	189	Menstruates 1 to 5 times a year	Ovaries	+			-	1 year 5 months
7	27	190	Menstruates every 3 to 6 months	Ovaries	+				No later reports
8	23		Menstruates 4 to 5 times a year	Ovaries	-		+		4 months
9	27	Overweight	Menstruates every 3 to 6 months	Pituitary and ovaries	+	8 months	+	+	11 months
10	37	Overweight	15 months	Ovaries	-		-	-	8 months
11	33		2 years	Moderate voltage; ovaries	-		-		3 months
12	29	181	3.5 years	Moderate voltage; ovaries	-		-		1 year 10 months
13	24	Normal	4.5 years	Ovaries	-		-		5 months
14	28	126	5 months	Ovaries	+ ²		-	+	7 months
15	25	Normal	2 years	Ovaries	-		+	+	
16	31	192	9 years	Pituitary	-		-	Relief of hot flashes and definite improvement	1 year 3 months
17	24	Normal	Menstruates 3 to 5 times a year	Pituitary	+ ²		-		3 months
18	33	Overweight	6 months	Pituitary	+	Regular to present		+	5 months

²Questionable if due to irradiation.

curred in one patient. In one patient, no effect was noted. The fourth patient obtained definite relief from hot flashes and her general health was improved. It has seemed that the markedly obese patients have been more susceptible of improvement by irradiation than have those who were underweight or nervously exhausted. The presence of periodic molimen seems likewise a favorable prognostic sign.

Of the ten married patients in this group, one has become pregnant. This patient, aged thirty-two, weighing 213 pounds, had had irregular periods with scanty flow from the onset of menstruation at eleven years. The intervals have varied from two months to two years. She had been married seventeen years, and had not been pregnant. There had been an extremely rapid gain in weight during the last ten years. Hot flashes were frequent and annoying. There had not been any menstrual flow for two years. Irradiation was applied in April, 1927. Menstruation was promptly re-established and continued for five months, when the first pregnancy occurred. In May, 1928, a full-term female child weighing almost 10 pounds was born. The attending obstetrician reported that labor was slow and difficult, due, in his opinion, to the amount of fat in the birth canal. Although the child was well developed and heart action was vigorous, respiration was not established spontaneously and all methods of forced respiration failed. The physician was unable to account for the difficulty, but reported that an identical case had come under his observation within a short period. The patient again menstruated regularly for three months, when a second pregnancy occurred.

For the cases of menorrhagia and metrorrhagia we have employed only exposures of the pituitary gland or of the pituitary gland and spleen combined. This choice has been due to the familiar observation that after

the initial dosage of irradiation in the treatment of uterine fibromyomas or pelvic carcinomas more profuse hemorrhage may occur. Since the amount of bleeding in the majority of cases under consideration is already alarming, we have hesitated to risk an initial aggravation of the bleeding. With the conviction, however, that the alteration in the ovaries is of the same nature in these cases and in those of amenorrhea and oligomenorrhea, we are contemplating the use of direct irradiation of the ovaries in the future. Table II presents the results obtained in the treatment of menorrhagia and metrorrhagia.

The value of irradiation in these disorders is difficult to determine because the series is small, spontaneous remissions frequently have been noted, and in some cases irradiation has been combined with other forms of treatment. In four patients who received irradiation of the pituitary gland alone, the amount of flow was reduced and was regulated for periods of from five months to one year after treatment. In one patient, although the amount of flow was satisfactorily moderated, dysmenorrhea remained unrelieved and after an interval of two months she was given a castration dose of irradiation. In three unusually severe cases in which a combination of several forms of treatment was employed, control of excessive bleeding persisted only two weeks, five months, and one year, respectively.

Our experiences with radiotherapy for dysmenorrhea (Table III) indicate promising results in this field. Although treatment has been relatively ineffective in two of six cases, definite improvement was obtained in one, and three of the patients have experienced prompt and gratifying relief.

The relief incidental to irradiation of vascular phenomena, ordinarily referred to as hot flashes and profuse sweating, has been noted in certain patients with amenorrhea.

TABLE II, RESULTS OF IRRADIATION IN CASES OF MENORRHAGIA AND METORRHAGIA

Case	Age, years	Hemoglobin, per cent	Type of menstruation	Previous treatment	Result of previous treatment	Organ irradiated	Supplementary treatment	Comment
1	15	29	Extreme metrorrhagia and menorrhagia	Intra-uterine radium; hemostyptics	Temporary check	Hypophysis and spleen	Transfusion; calcium lactate; sistomensin	Menstruation moderate in amount and only slightly irregular for 1 year. Then return of menorrhagia and metrorrhagia
2	17	49	Extreme metrorrhagia and menorrhagia	Glandular; tonics, dilatation and curettage	Practically no effect	Spleen and liver; after 6 months pituitary and spleen	Rest in bed; sistomensin and calcium lactate at time of menses	Flow checked for 5 months. Normal menstruation for 3 months. Then metrorrhagia returned
3	23		Extreme metrorrhagia and menorrhagia	Dilatation and curettage twice Mammary extract Corpus luteum Calcium lactate and sistomensin	No effect Temporary check Temporary check	Hypophysis	None	Irregular flow for 6 weeks. Then amenorrhea for 3 months. Then 4 moderate regular menses. Irregular flow recurred 8 months after treatment
4	26	76	Menorrhagia and dysmenorrhea	Intra-uterine radium Mammary gland; sistomensin and calcium lactate	Temporary check Some regularity, temporary	Hypophysis	None	Appreciable decrease of flow and dysmenorrhea for 6 months
5	31	43	Menorrhagia	Intra-uterine radium; calcium lactate and sistomensin	Temporary check	Hypophysis and spleen	None	Satisfactory regulation to present time (5 months)
6	33	65	Metrorrhagia and menorrhagia	Ovarian extract over long period; intra-uterine radium	Slight regularity	Hypophysis	None	Profuse and irregular flow checked for 5 months. Less headache. General health improved. Then relapsed to former condition
7	36	50	Menorrhagia and dysmenorrhea	Dilatation and curettage; ovarian extract		Hypophysis	None	Definite reduction in flow. Little influence in dysmenorrhea; only 2 months observation period
8	18	14	Extreme metrorrhagia and menorrhagia	Dilatation and curettage	Check for 3 weeks	Hypophysis	Calcium lactate and sistomensin	Immediate cessation of flow for 2 weeks only; more moderate but irregular flow resumed

TABLE III, RESULTS OF IRRADIATION IN DYSMENORRHEA

Case	Age, years	Degree of dysmenorrhea	First irradiation	Result	Second irradiation	Result	Third irradiation	Result
1	25	Requires opiates with each period, frequently faints with pain; in bed 3 to 4 days; exhaustion throughout interval	Pituitary, June, 1928	Some pain but of short duration; patient had never experienced similar relief from any type of treatment previously	Pituitary, July, 1928	Slight dysmenorrhea for 2 periods of few hours duration; third period more painful	Irradiation of pituitary and ovary combined, September, 1928	Absolutely free from pain
2	24	No relief except with narcotics; unable to work or attend school	Pituitary, June, 1927	Definite improvement for 2 months; third period more painful	Pituitary, October, 1927	Comparative relief for 9 months; general health improved; able to work continuously from January, 1928	Pituitary, July, 1928	Complete relief to present time
3	30	Incapacitated 2 to 5 days; opiates used frequently	Pituitary, September, 1927	Next period without prodroma and very slight pain; relief continued 6 months	Pituitary, March, 1928	Less marked relief for 5 months		
4	26	Profuse and very painful periods, with nervous exhaustion	Pituitary, June, 1927	Definite relief for 6 months; gradual return of more profuse and painful menses after that time				
5	27	Constant exhaustion on account of prolonged and extreme dysmenorrhea; unable to attend school	Pituitary	No change first period; second and third periods shorter and slightly less painful	Pituitary with heavier dosage; about 20 per cent unit skin dose	No report		
6	36	Constant depression and exhaustion due to dysmenorrhea and profuse flow	Pituitary, July, 1928	Flow reduced in amount; pain unaltered	Pituitary, July, 1928	No effect on subsequent period		

Immediate cessation of flow for 2 weeks only; more moderate but irregular flow resumed

and sistomenin

Irradiation of the pituitary gland applied in five cases following the menopause, because of the severity of these symptoms, has given a successful result in three cases, but was without effect in two cases.

Experimental Studies. — Experimental studies dealing with the effects of irradiation of the ovaries of white rats with reference to the regularity of estrual cycle, fertility, and conditions of the offspring have been carried on during the last two years. The irradiation has ranged from 5 to 250 per cent of a human unit skin dose, or, roughly, 1 to 100 per cent of a rat erythema dose, applied through a carefully directed field, over the abdominal or dorsal surface. The attempt has been to irradiate the ovaries with the least possible generalized exposure. All of the animals used were isolated females which had normal estrual cycles before irradiation; some rats of each litter were used for control studies. In connection with other experiments it had been found that handling and anesthetization of the rats did not have any influence on the regularity of the estrum. Following irradiation twenty of forty-two rats showed temporary irregularity of the estrual cycle. This consisted in omission or postponement of the next estrual period, prolongation of the stage of desquamation of cornified elements, or irregular diestrual intervals. This effect occurred without relation to the amount of irradiation used. That a slight systemic reaction incident to irradiation is the cause of such variation is doubtful, when the extremely low dosages at which it occurred are taken into consideration. In every instance, the estrual cycle again became regular. Our work in this respect is in accord with that of Parkes and Brambell, who, with massive irradiation, were unable to check the estrual rhythm of white rats.

The rats have been killed at varying pe-

riods after irradiation and the ovaries have been studied in serial sections for evidence of irradiation effect. During a period of two to eight days after irradiation occasionally a higher proportion of primordial follicles undergoing degenerative changes has been noted. In all the ovaries, however, healthy mature follicles and corpora lutea were present. Schoenhof and Wagner have applied irradiation of low dosage to the ovaries of women shortly before laparotomy and were unable to find histologic evidence of a harmful effect of irradiation with dosage equivalent to 5 to 20 per cent of the human unit skin dose. Parkes and Brambell have reported degeneration in all of the follicles in the ovaries of the animals irradiated according to their technic.

Twenty-four irradiated rats have been mated at varying periods after irradiation (Table IV). Twelve rats became pregnant. Sterility in two instances was explained by the finding of bilateral pyosalpinx at necropsy; in two others, the lack of fertility probably was due to the age of the animals, as the control rats of the same litter also were sterile. In the remaining eight rats, sterility is unexplained. With the application to each rat of doses of one rat erythema unit to a field directly overlying the ovaries, sterility has resulted in five of ten animals. One that became pregnant was mated eight days after irradiation. She produced a healthy litter of nine young. A latent period before sterility is produced by irradiation has been described by Robinson. Pregnancy occurred in two others, one of which resulted in abortion; the second rat died in labor after it had suffered from diarrhea and nutritional disturbances throughout the pregnancy. With the lower dosages of irradiation, healthy litters have been produced and the second generation has been normal. These experiments will be extended and reported in greater detail in a later study.

TABLE IV, EFFECTS OF IRRADIATION OF THE OVARIES ON THE FERTILITY OF WHITE RATS

Rat	Irradiation, unit skin dose	Days before mated	First litter	Second litter	Second generation	Fertility	Comment
1	1/5	93				Not fertile	
2	1/5	93				Not fertile	Pyosalpinx found at necropsy
3	1/10	106	Aborted				
4	1/5	93				Not fertile	Pyosalpinx found at necropsy
5	1/20	106					
6	1/20	106	5 normal young		Normal		
7	1/20	100	5 normal young		Normal		
8	1/10	100					
9	1/20	100	4 normal young				
10	1/20	100	5 normal young				
11	1/20	100	3 dead young	1 died soon after birth			
12	1/20	75	5 normal young	3 normal			
13	2.5	32				Not fertile	
14	2.5	32	Aborted			Not fertile	
15	2.5	32	Mother rat died in labor				Emaciated; severe diarrhea during pregnancy
16	2.5	97					
17	2.5	97	2 normal (one died at birth)				
18	2.5	9	9 healthy young				
19	2.5	8				Not fertile	
20	2.5	46				Not fertile	
21	2.5	46				Not fertile	
22	2.5	46				Not fertile	
23	1/10	230				Not fertile	
24	1/10	230				Not fertile	Unirradiated rats of same litter also sterile at this age

SUMMARY

Irradiation of ovaries or hypophysis has been effective in re-establishing menstruation in patients in whom prolonged use of organotherapy had been ineffective.

A conclusion cannot be drawn as to the comparative efficiency of methods, because the cases selected for irradiation were of unusual severity.

Irradiation of the hypophysis, occasionally combined with splenic and hepatic irradiation has exerted a temporary regulating effect in seven cases of severe menorrhagia and metrorrhagia; with supplementary treatment, the effect in two cases has persisted more than one year.

Relief of dysmenorrhea has been incidental in certain cases of menorrhagia and oligomenorrhea. Of six cases treated primarily for dysmenorrhea, relief has been complete in three and has lasted for a period of four to six months; improvement occurred in two others.

Irradiation of ovaries of white rats in various dosages has resulted as follows:

There was no continued influence on the regularity of the estrual cycle.

Complete destruction of follicles did not result from dosages up to 2.5 unit skin doses (H.E.D.).

There was no influence on fertility, except in cases in which there was marked systemic reaction, with irradiation of 50 per cent unit skin doses or below. With the application of two and a half unit skin doses sterility has been produced in five of ten rats. In one instance in which the animal was mated eight days after irradiation, a normal litter of nine young was produced. Abortion and maternal death resulted in two cases.

Abnormality in the progeny has not been demonstrated.

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ROENTGEN THERAPY IN FIBROMYOMATA AND OTHER BENIGN GYNECOLOGIC CASES¹

A CLINICAL REPORT OF TWELVE YEARS' EXPERIENCE

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THE clinical conclusions herewith presented are based on results observed not only immediately after the termination of treatments, but, also, after several years have elapsed. We have treated a total of 596 cases which properly come under this title, including eighteen miscellaneous ones not described. Of this total, only eleven persons seem to be hopelessly lost. The majority of cases we have been able to follow for from one to five years, and in a surprisingly large group, from five to twelve. A woman who is well after so many years furnishes almost conclusive evidence of the permanent value of the treatment. From our records, from the physician referring the case, from the patient or her family we have made these estimates, which, while far from absolute, conform more or less exactly with those of many roentgen therapists in Europe and America.

TECHNIC

Through the years our technic has proven itself to be safe and efficacious. We still hold to the low voltage (100-120 kilovolts), to the cross-fire method, and to treatments in series several weeks apart. An exact statement of technic is impossible, because the requirements of the individual cases so often call for changes that one cannot maintain a uniform technic. More recently, the patient has received less radiation rather than more, and the ovaries have been excluded, so far as possible, earlier than formerly. Throughout this paper we refer to the low voltage technic, unless otherwise stated, because we believe it best adapted to the cases herein described.

Management is as important a factor as technic. Attention to the needs of each individual; a flexible régime for many women who do not conform to general rules; frequent check-up examinations, noting the changing pathology, as to progress and location; a decision whether to give or to withhold more X-ray, or whether to call the patient back for further examination in six weeks or six months. If improvement is too slow, what is the reason? In other words, the experience of the gynecologist should be added to the skill of the technician. The latter without the former leads to disappointment if not to injury.

The *fibromyoma* is the pathology most frequently presented to the roentgen therapist who specializes in women's diseases. We have treated 350 cases. But, before the general discussion of fibroids, I wish to speak of etiology as a thing pertinent to the subject and in literature too vague to be practical. Fibroids are said to present themselves more often in nulliparae. Hence, one authority gave a "disappointed uterus" as a factor; another said that a uterus that does not grow babies will grow fibroids. In our series, however, we find 65 per cent of the married women have had from one to six children.

I venture here to present some common etiologic factors, all having one constant condition, and that is, a *long-continued, passive congestion of the pelvis*. Indeed, almost any degenerative change may be caused or hastened by this engorgement of slow-flowing blood, which is more often given as a *result* of the disorder than a *cause*. The chief conditions causing these chronic and ever-present congestions are:

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1. Abortion, with its group of protesting tissues after neglected inflammatory exudates.

2. Retroversion of the uterus, which causes venous engorgement and compels poor drainage. These conditions finally cause histologic changes (1).

3. Infections, which result in thickened, indurated tissues.

4. Sacro-iliac lesions, lumbosacral twists and other displacements in the lower spine. Besides chronic congestions, these cause backache, and very sore pelvic nerves. The important clinical point is that some individuals who have responded well as to the relief of the fibroid, tire too easily and have the old backache and the sacro-iliac pain.

HISTOLOGIC STUDIES

Another important preface to a discussion of fibroids is a brief consideration of the histologic changes in the tissues subjected to X-ray, changes which give us the reasons for the therapeutic value of X-radiation.

1. The fibroid tumor cell, by successive steps, is obliterated and replaced by young connective tissue (2).

2. Ovarian stimulation is inhibited, probably by the effect, first, on the ripened graafian follicles, then the ripening follicles, and last, if the ray is continued long enough, on the primordial follicles and the interstitial tissue (3).

3. X-ray has a direct influence on glandular tissues. The utricular glands and the glands of the cervix uteri soon become less in size and function. This is also brought about through the effect on the ovaries (4).

4. In the blood vessels X-ray produces an edema of the endothelial lining of the capillaries, which causes an endarteritis obliterans, thus limiting the too abundant blood supply (5).

5. The internal secretions, under the small ovarian dose, seem not to be affected, as the interstitial tissue and the corpus luteum are the last to be influenced (6). Apparently the treatments may be discontinued long before the hormones are affected at all.

Geist's histologic studies have established three important things about hemorrhage: First, that the ovaries are the disturbing factor either in the activity of the follicle or the corpus luteum. The proof is that the removal of the ovaries cures all hemorrhage with or without gross lesions except cancer. Second, that there is hyperplasia and hypertrophy of the glands and the cells of the stroma; also, there is a marked hypertrophy of the mucosa, the glands being tortuous, distended, often cystic, and sometimes increased in number (7). Third, that "X-ray affects the follicle apparatus and destroys it. We also know that bleeding due to fibroids or to essential hemorrhage can be absolutely controlled by raying" (8).

Judging by the above histology, the artificial menopause induced by moderate doses of X-ray can not be differentiated from a normal menopause (9).

CLASSIFICATION OF FIBROIDS

From the X-ray therapeutic standpoint, all cases of fibroids may be classified in three groups:

1. Those that should be rejected because of well established contra-indications.

2. Those that may with good reason be accepted, but with guarded prognosis.

3. Those highly suitable for X-ray therapy and which yield uniformly good results.

Contra-indications.—Under the first group, those to be rejected, we find one or more contra-indications, as follows:

1. Degenerative changes in the tumor itself, as cystic or calcareous degeneration; necrosis of the tumor, with severe acute

symptoms; sudden softening or rapid increase in size are suspicious, especially if cachexia develops. (A sudden severe anemia, not fully accounted for, or a cachexia is a warning in any case.) But remember that the blood condition due to hemorrhage, *with focal infections*, may closely resemble cachexia. This has been observed in eighteen of our cases.

2. Fibroids associated with carcinoma are not suitable to the low voltage technic.

3. A pedunculated tumor, where obstructive torsion is imminent, is better extirpated.

4. A fibroid associated with large proliferating or solid ovarian tumors belongs to the surgeon. This does not include the simple retention cysts of the graafian follicles.

5. The subserous tumors in the child-bearing period should be enucleated if children are desired.

The above contra-indications are legitimate guides to practice. My failures are in exact ratio to my inability to recognize these.

The second fibroid group, consisting of cases accepted but with guarded prognosis, may not yield results entirely satisfactory and yet may properly belong to X-ray therapy. The first of these include women who present complications but who are poor surgical risks. In some of these cases my decision to accept the patient for treatment proved unwise, but was made deliberately with the hope that a case almost certain to die in operation might be so improved with X-ray, time, and general care that an operation could be undertaken with less risk. In four cases an operation was later performed successfully. In some cases, however, surgery will never be possible. To these women the roentgen therapist can offer a definite relief not obtainable through any other method. Other women of this group are

those who cannot turn aside from their business or their home duties for hospitalization; and also those who refuse to submit to surgery. A choice of procedure should be given after a full understanding as to prognosis. We have been surprised to find that a large percentage of these cases yield excellent results as to health and comfort.

The *submucous tumor* should be treated with guarded prognosis and belongs to the above group. It is estimated that about 10 per cent of all fibroids are complicated with the submucous tumor, which often recovers, with the primary tumor, under treatment. Later, however, if there is an occasional showing of blood after the regular menses have disappeared, and if the conditions in general are satisfactory, it has, in my cases, been pathognomonic. Bécclère, of Paris (one of our most experienced pioneers), reports 700 cases of fibroid treated with X-ray, with 1 per cent failure due to the submucous tumor (10). Three of my earlier cases came to operation; none was malignant; more recently four have seemed to recover with X-ray therapy only. To these cases we are now giving more time, *if all symptoms are favorable*, but we do not forget our responsibility. In the twelve years, however, no case has proved malignant.

In the third group, those favorable to X-ray therapy, are (1) the subserous tumor; (2) the non-vascular intramural, with no hemorrhage, and (3) the vascular intramural, with hemorrhage.

Clinically considered, the results with subserous tumors in older women are uniformly successful. The regression takes a little more time, but new growths do not follow and the woman is in excellent health. In the history given to me by several of my patients new growths did appear after surgery: X-ray treatments overcame in these both the tumors and the tendency toward their formation. (For the young woman

who hopes for children, myomectomy is advised, as above stated.)

The large non-vascular intramural tumor, without hemorrhage, was at one time included in my contra-indications. We read that a fibroid larger than 15 centimeters in diameter should be operated upon, but a far better rule for selection is the general suitability of the case, rather than the measuring rule. Large non-vascular tumors are sometimes almost spectacular in their response to roentgen therapy. They subside more slowly than the hemorrhagic type, but are usually very satisfactory. One of these large non-hemorrhagic tumors grew an inch above the umbilicus and was complicated by a subserous tumor the size of an orange. With good reason, her physician (a surgeon) advised against operation. Gradually both tumors disappeared. To-day, after ten years, at the age of 59, she is in superb health and is doing efficient work in an exacting position.

Last, and best of all cases, is the intramural of the hemorrhagic type that fortunately constitutes about 77 per cent of all fibroids (11). When these occur in women of 40 years or more they are ideal for X-radiation. In almost 100 per cent of the cases the tumor disappears in a few months.

Younger women.—If in younger women a temporary amenorrhea is the objective, we early reduce the amount of X-radiation and exclude the ovaries even more carefully (with entire success to the case). My patients, numbering 20, are from 26 to 35 years of age. The primary shrinking of the uterus and ovaries, sometimes seen after X-ray therapy, is often transient. I have seen this phenomenon: first, the ovary shrinks to a small indurated mass, due probably to the disintegration of the ripe and ripening follicles; second, after some time has elapsed, the ovary will be found larger, and in favorable cases may return to normal size and consistency. The uterus shares this very

desirable recovery which occurs when the primordial cells develop and begin to function. Since these cells are last to be influenced by X-radiation, the recovery may be expected in young women, if the X-ray has been applied judiciously. If early in this transition period the pelvis is examined (as during an operation, for instance), the effects of X-radiation are always overestimated (12). It was in these recovered cases that the menses were resumed in from three months to three years in 14 of our 20 cases, and, though it is too uncertain to allow of prognostication, conception is possible. Among six married patients, we have had one who gave birth to a normal child at full term.

One case in illustration.—My youngest patient was 26. One cesarean child was delivered in the presence of a multiple fibroid. Operation was refused. Diathermy and other methods failing, the menses becoming painful and hemorrhagic, X-ray therapy was applied cautiously. Amenorrhea resulted. After five months menses were resumed normally and regularly, with no pain, and the fibroid was not demonstrable. This is reported because it is an unusually gratifying case, and because it illustrates what can be done, but as to prognosis no definite promise should be made.

Dr. Newcomet, of the Presbyterian Hospital, Philadelphia, emphasizes similar principles and applies the small dose to women of 30 to 35 years of age (13). Dr. Knox, of St. Luke's Hospital, New York, states that women from 25 to 35 years of age, after amenorrhea for two or three years, may resume menstruation (14). Dr. Buck, of Rochester, N. Y., treats women as young as 20 years of age and reports three pregnancies in 315 cases (15).

In the treatment of fibroids with X-radiation the question of exacerbations of chronic inflammations is of interest. In the admirable report of Dr. Frances A. Ford, of the

Mayo Clinic, she says: "Though presumably 40 per cent of the cases treated by roentgen ray or radium would show chronic pelvic inflammation if exposed . . . active inflammatory reaction to radium or roentgen ray is relatively rare" (16). She calls attention to Bécclère's statement that he never encountered such a reaction in roentgenologic treatment although it occasionally follows the application of radium (17). Dr. Polak declares that the X-ray is safer than radium for the control of uterine bleeding associated with any inflammatory pelvic condition (18).

We have never seen one of these reactions. If in grave doubt, however, we preface X-radiation with three or four diathermy treatments, which may help to avoid reactions, and the patient is at once more comfortable.

Ovaries.—Many ovaries, not really diseased, are enlarged in the presence of a fibroid, and in almost every instance they become normal as the vascular engorgement subsides. There are, however, ovarian enlargements which indicate moderate tissue change and they may need supervision even after general treatment is discontinued. This group comprises the instances of the non-proliferating type of degeneration, in which the ovary may assume the size of a lemon or a small orange. Such are associated with the graafian follicles and are promptly remedied. A few of my cases have seemed to share with the uterus a fibrous change. These repair more slowly than the retention cyst. Of the above types I have had 92 recovered cases out of 93 in the twelve years, and, so far as I can ascertain, none of them has proved troublesome.

The proliferating cystadenoma, the stromatogenous cyst, the dermoid or the teratoma, are uninfluenced by X-radiation either as to the cause or cure, and, as stated above, are at once surgical. If they occur with fibroid tumors, and are not at first

recognized, the X-ray treatment has not to my knowledge jeopardized the surgical success of any case.

Cervix uteri.—The cervix uteri may require as much attention as the fibroid itself. Even remembering that cancer is said to attack the cervix eight times as often as the fundus, and that an erosion may be potential cancer, I am convinced that selected cases of the cervix uteri belong to the favorable class for X-ray therapy. To date, as far as I know, not one of our 88 cases has made trouble. There is little doubt in my mind but that some of these were pre-cancerous, or even incipient cancers, which, taken early, responded to X-radiation. If not, why in twelve years have they not developed our *pro rata* share of cancers? According to accepted statistics, our records, which show one, should show seven or eight. At least it is quite conservative to say that X-ray therapy is a safeguard and minimizes the danger.

Hemorrhage of the menopause.—Because of Geist's studies, mentioned above, we understand better why hemorrhage of the menopause is favorably influenced. The cases of so-called "essential hemorrhage" (or ovarian dysfunction) are said to be without pathology, but with a large, boggy uterus, or with fibrosis, or with the conditions so often found by Geist, they seem to me moderately but distinctly pathologic. However this may be, small doses of X-radiation over ovaries and uterus are almost specific. To date, all of these women, numbering 23, have remained well.

Dysmenorrhea.—In a woman 35 years of age or more, any case of dysmenorrhea that has resisted all measures of relief and is incapacitating should be ended by X-ray therapy. We have treated a total of 24, and the results have given great satisfaction. To see a woman resume her former occupation without the haunting remembrance of the prostrating pain, is to be convinced that

menstruation is not essential to a woman's happiness or welfare.

A few questions are asked so often that there is evident misunderstanding not only among laymen but physicians.

1. If the tumor is not treated surgically, is there greater danger of cancer? As I have said before, X-ray therapy seems to be a safeguard, but, to give an authority, I quote an editorial in the *Journal of the American Medical Association* (Oct. 13, 1928): "Women who have been treated by radiotherapy, whether it be roentgen rays or radium, are not more prone to cancer than are normal women."

2. Does X-ray therapy injure a woman sexually? I have taken great pains to ascertain the truth on this apparently urgent question. Many of my patients assure me that, since being relieved by X-ray therapy, intercourse has been resumed normally because of absence of pain and the fear of conception. The knowledge that the pelvic organs are all intact, helps. I have previously quoted Bride, of London, who says that 39 per cent of his patients who have undergone operation are disturbed in sex relations (19). In general, it is safe to say that X-radiation in small doses, not frequently repeated and not continued too long, does not affect sexuality.

3. Will a woman become obese? If the woman is naturally obese, she will probably remain so, and after the menopause she may gain weight, as women did before the X-ray was discovered. But under conservative application of X-radiation she is no worse than she would have been without it.

4. The questions prompted by the perennial fear of X-ray "burns" are many. The fact that we have had no burns nor other accidents in more than twelve years, proves that they can be eliminated.

CONCLUSIONS

In conclusion, in addition to the beneficial effects of roentgen therapy on the gross

pathology discussed throughout this paper, we now confidently expect to establish a reparative circulation, which leads to softening of indurations, to reduction of old inflammatory exudates, to correction of parametric lesions, to modifications of adhesions to such extent that the pelvic viscera are freely movable, and in many cases displacements are remedied. All these to the credit of roentgen therapy. What single remedy can do more?

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DISCUSSION OF PAPERS BY DR. DRIPS AND
DR. FORD; DR. HANKS

DR. I. S. TROSTLER (Chicago): For fear that I might overstep the time allotment if I attempted a verbal discussion of this subject, I have written such points as I think should be stressed.

Dr. Ford and Dr. Drips covered their subject in a most thorough and exhaustive manner. They brought this out very well at the last meeting of the Americal Medical Association in Minneapolis, and in their paper, published in the *Journal of the American Medical Association* of Nov. 3rd last.

There is no question in the minds of well informed roentgenotherapists but that we have a highly efficient agent for the control of dysmenorrhea and uterine hemorrhage, either in the form of menorrhagia or metrorrhagia, when the dysmenorrhea or hemorrhage is not due to infection of the uterus or adnexa. With the delicacy of control of dosage to be had at the present time, there need be but little fear of producing a permanent menopause (or what amounts to a roentgen castration) in young women, unless that be the aim and purpose of the treatment.

In nine cases of dysmenorrhea of severe type, treated by me, all except one were markedly relieved, and in only one of these were the menstrual periods interfered with, as regards recurrence. In that one case there was complete amenorrhea for one year, with resumption of painless normal menstruation at the end of that time.

Incident to this particular subject, I have what is to me a very interesting case to report.

Mrs. H. A., age 26 years, IVpara, mother of two children and suffering from a moderately advanced pulmonary tuberculosis and mitral regurgitation, was referred to me for roentgen sterilization in March, 1918, by a competent general practitioner. I insisted that we have a heart and lung

specialist see her, and after the latter had agreed with the diagnosis, I proceeded to produce a roentgen castration. March 6, 1918, she received 75 milliampere-minutes, $9\frac{1}{2}$ inch spark gap, 10 inch F.S.D., through 5 mm. sole leather and 3 mm. Al.: March 27, 1918, the same dosage except 5 mm. Al.; April 17, 1918, same, except 6 mm. Al.; May 7, 1918, same as last dosage, making a total of 300 milliampere-minutes, at $9\frac{1}{2}$ inch spark gap (practically 140 K.V.P.).

Her last menstruation before beginning treatment had occurred Feb. 25 to 30, 1918. May 20 to 25 she had a very profuse period; April 22 to 25 she flowed considerably less than normal, and May 19 she had "just a show" of blood. Patient reported July 10, 1918, that she felt well and had not menstruated since the last report.

May 10, 1928, this patient informed me that she had begun to menstruate the day before. She looked well, and was directed to see me again within a few months. Since that time she has menstruated regularly, appears well, and is apparently normal, after having had a complete amenorrhea for ten years, lacking ten days. She stated, after questioning, that sexually she had been normal all this ten years.

Regarding fibromyomata, my experience, covering some twenty-odd years, verifies the reports of Dr. Hanks in every detail, and I am glad to note that she remembers that she is a physician first and a radiotherapist afterwards. I have presented several papers upon this subject from time to time, and have no reason to retract any of the somewhat broad claims that I have made for roentgenotherapy as a preferred treatment, wherever and whenever that condition is present, *in the absence of infection*. Of late, I am not so sure that we should not treat these cases *even if infection is present*.

DR. HENRY SCHMITZ (Chicago): There is very little left to be said. The investiga-

tions reported by Dr. Drips and Dr. Ford are very valuable as the treatment of amenorrhea is so unsatisfactory, especially in cases of long standing. If anything can be added to our armamentarium which can improve the results of treatment, it should be given careful trial.

The doctors tell us that some of these cases occur in very obese patients, while a lesser number appear in so-called asthenic or weak patients. It has been our custom to reduce the weight of such patients by diet and vigorous exercise. At the same time, extract of the anterior lobe of the pituitary is given hypodermically and thyroid extract in small doses orally.

We have been very reluctant to use the roentgen ray over the ovaries and hypophysis. However, considering the good results from radiation treatment we shall again use it with the hope of obtaining results as good as reported by Dr. Drips and Dr. Ford.

Concerning the bleeding uterus, it would be well to remember that the underlying causes are varied. In the first place, in the matter of a profuse menstruation occurring at the regular time, that is, where the interval has remained perfectly normal but the amount of blood lost is greatly increased or the duration of the flow is prolonged, such conditions are not due to ovarian disturbance, but result from uterine disturbance—either the power of contractibility of the myometrium is decreased or the blood supply to the uterus has been increased. Correction of either condition will bring about normal menstruation.

However, if menstruation occurs too frequently, that is, within intervals of twenty-four days or less, then the cause should be attributed to a disturbance of ovarian function. If palpable changes are present they should be corrected by indicated surgical measures, while functional disturbances frequently yield to endocrine therapy.

If the menstruation occurs too late, one should think of two conditions: (1) a relative amenorrhea, usually characterized by scanty menstruation due to decreased function of the ovaries, or (2) a hemorrhagic myopathy due to a persistent graafian follicle.

It is the latter class of benign metrorrhagias that indicate radium and X-ray therapy, if occurring at the close of menstrual life.

DR. F. J. TAUSSIG (St. Louis): Dr. Drips and Dr. Ford's paper, dealing largely with radium treatment in cases of amenorrhea, was of special interest to me because I have had in the past five years a group of these cases with a rather astonishing percentage of successes. I analyzed these cases and found, of the fourteen cases where the treatment was given for amenorrhea, there was a success in producing menstruation for a period of time in about 60 per cent.

On analyzing this group more closely, I came to a rather astonishing figure. I found that the one case in which menstruation had not existed at all was that of a woman about twenty years of age, with a uterus of fairly normal size which was not influenced by radium treatment. In eight other cases where the menstruation was at intervals of five to eight weeks and was scanty, the percentage of successes was not over one-half, and in none of these cases, although the women came because of sterility, was the treatment able to influence them favorably. None of these patients became pregnant.

On the other hand, there were five patients in whom menstruation came at intervals of from three to eight months—normal when it did come but the interval was prolonged. All of these five women had been treated with corpus luteum, thyroid, and various other products, without any avail. Four of them responded favorably as a result of the packing of seventy-five

milligrams of radium for from five to six hours in the posterior vaginal fornix. A normal menstruation followed in a period of from six to eight weeks after this treatment. Of these four, three became pregnant. This was a rather striking thing, and one of these women has had two children since this treatment. In several of them a Dudley operation for sterility had been done without avail, so that I feel, in this type of amenorrhea particularly, that the use of small doses of radium should be given very careful consideration. In my experience, it is infinitely more effective than any of the organo-therapeutic products on the market.

DR. H. J. ULLMANN (Santa Barbara, Calif.): I was particularly interested in Dr. Ford and Dr. Drips' paper because, several years ago, following a report in the *British Journal of Radiology*, from a Vienna clinic, on the relief of hot flashes by radiation of the pituitary, I attempted it on a patient who was going through the normal menopause and who was being awakened many times during the night by hot flashes and was quite miserable. We gave her at that time, unmeasured from the ionization chamber standpoint, a dose which later was calculated as approximately $8\frac{1}{3}$ per cent of a sub-erythema dose, giving it once every two or three days, with marked relief in the number of hot flashes.

In the original article, the suggestion was made that the effect was an inhibition of the pituitary, and to check this we increased the dose, without the patient knowing it, to approximately $11\frac{2}{3}$ per cent—an increase of 42 per cent of the previous dose—with a marked increase of symptoms lasting two days. It made her miserable. We gave her a week's rest, went back to the $8\frac{1}{3}$ per cent, with immediate relief once more.

We are using it on some other cases, but we are not ready to report on them.

There is one use of radiation in pelvic conditions that has not been brought up, but I believe it is becoming of considerable importance. That is the acceleration of the normal menopause by radiation in patients with a menopause psychosis. I have treated a number of cases referred to me by a psychiatrist with such excellent results that he says he is going to refer all cases of that type in the future until proved wrong.

We had one experience a few months ago when a patient who was sent to me for radiation of a large fibroid uterus denied she was pregnant. She had menstruated two or three times following her last pregnancy, but I was not sure of the diagnosis. We took a roentgenograph and found a normal breech presentation, which saved a lot of grief.

THE DIAGNOSTIC DEPARTMENT OF A GENERAL HOSPITAL¹

By FRED JENNER HODGES, M.D., Roentgenologist, St. Mary's Hospital,
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COMPLETE, thoroughgoing physical examination of every patient who presents himself for medical advice would undoubtedly result in fewer diagnostic errors and more effective treatment. Complete examination, however, includes a great many procedures requiring special laboratory equipment available only in large private clinics, co-operative laboratories, and hospitals, while most patients report to their physician at his office. The cost of special examinations done singly is so great in the aggregate as to discourage the patient, and the physician's alternative is to limit his use of laboratory methods to those most likely to yield positive findings in a given case, a practice utterly opposed to the basic idea of complete physical examination.

So long as serological tests, chemical analyses, electrocardiograms, metabolic rate determinations, and roentgen examinations mean additional separate charges against the patient they will never be used with the freedom which their diagnostic value warrants. Impressed while visiting the Mayo Clinic by the lavish employment of laboratory aids to diagnosis for which no itemized statement is rendered, two members of the staff of St. Mary's Hospital, Madison, Wisconsin, decided to inaugurate a special department of diagnosis in that hospital. The purposes behind this plan were:

(1) To make the fullest possible use of the hospital's extensive laboratory equipment.

(2) To centralize and co-ordinate diagnostic effort within the hospital.

(3) To extend greater service to the various staff members and their patients.

(4) To lessen the growing evil of excessive medical charges to the patients.

Accordingly, after a careful study of actual costs in previous months, it was estimated that patients could be admitted to the new "diagnostic department" for a minimum of two days at a *per diem* charge of \$12, in addition to their room charge ranging from \$2.50 to \$7.50. A hitherto unused part of the hospital, remote from other services, was prepared to accommodate patients to be admitted on the new basis. A full-time house officer was assigned to duty in the new department and as a temporary arrangement the roentgenologist agreed to supervise the work. The \$12 charge for a minimum of two days allowed \$24 per patient minimum to cover all diagnostic measures requested by the patient's physician. While this amount would quickly be expended if all procedures were to be itemized, it was found that the hospital could offer this service at a very small profit on a cash basis.

The new department was then presented to the staff, physicians in surrounding towns, and the public as an effort by the hospital to increase its usefulness by means of consolidated effort and reduced cost. Physicians learned that they could advise two or more days' stay in the hospital at a known minimum charge of \$29 to \$39, depending upon the type of room selected by the patient, and that they could order any or all of the laboratory procedures afforded by the hospital with no further thought of expense to their patient. Furthermore, a complete history and physical examination would be written by the house officer under supervision, and shortly after the patient's discharge a typed abstract of

¹Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3-7, 1928.

the entire case would be in the referring physician's hands.

Many patients were anxious to avail themselves of an opportunity to be thoroughly studied at a cost they knew to be within their means. The hospital was glad to enter into an arrangement whereby cases for diagnosis only could be segregated, thus enabling the laboratories to work more efficiently. The roentgenologist was delighted with his opportunity to study cases more thoroughly and after proper preparation. The increased activity in his department meant more work, to be sure, with smaller fees, but improved results as well as an appreciable reduction in the percentage of accounts receivable were gratifying.

The new venture was begun July 1, 1927. In the first twelve months 240 patients, 6 per cent of the total hospital census, were admitted. Very few cases were held longer than the two-day minimum. At the rate of 20 cases per month (which in this department means 20 working days), every patient received close attention and reports were promptly delivered to the attending physician. Copies of all reports in a bound volume constitute the cream of the hospital records for the year and the general character of all records has been improved because of this stimulus. The service is coveted by the internes and the hospital management has been pleased to find that 30 per cent of all admissions have subsequently returned for surgery.

It is felt that this scheme offers much to the physician in the way of modern hospital service without in any way interfering in his management of the case. Certainly from the roentgenologist's standpoint the situation is ideal and the Department of Roentgenology would rather examine a patient from this service than upon any other basis because its opportunity to render efficient service is so greatly enhanced thereby.

Certain minor difficulties in the matter of deciding how far into the specialties this service is to penetrate have arisen, but so far consultations have been exchanged between staff members without charge, to the mutual benefit of all concerned.

The wide variety of final diagnoses has justified the experiment, for many unsuspected cases of tuberculosis, hyperthyroidism, mental disease, and cardiac pathology have been brought to light. The number of abscessed teeth unearthed in routine examination has been most enlightening. It is interesting to note that of the 240 cases in the first year, gall-bladder disease, as determined by cholecystography, was discovered in 64, 22 of which were later operated on, with confirmation in all instances.

The plan of offering to physicians and the public the best concerted effort of all the diagnostic agencies of the general hospital at low cost is workable and profitable alike to physicians, hospital, and, above all, the patient.

OSGOOD-SCHLATTER'S DISEASE¹

By ROBERT B. TAFT, M.D., B.S., Riverside Infirmary, CHARLESTON, SOUTH CAROLINA

SINCE Osgood described a lesion of the adolescent tibial tuberosity in 1903 (1) various men have collected small series of cases and each has given his opinion as to the etiology. Again, Schlatter, in 1908 (2), described a similar condition which is now recognized as a clinical entity and generally known as "Osgood-Schlatter's disease," though occasionally as "Schlatter's disease."

It is interesting to note that as far back as 1869 the condition was described (8), but, of course, no very definite information was given, as that was before Roentgen's epochal discovery.

With a series of eight new cases and one old one, the author feels that this report is justified and hopes to bring to many practitioners further knowledge of this condition—commonly regarded as very rare, or, more often, simply overlooked. A search of the literature shows that this disease is not often reported, as most of the authors base their observations on one or two cases and the greatest number cited by any one author is seventeen (17). Bader (8) states that only one case was found in the Cincinnati General Hospital in six years. The author has picked up eight cases in twenty-six months and during that time he radiographed only twenty-six knees of youths between the ages of twelve and eighteen for fractures, foreign bodies, and all other causes. This leads him to believe that there must be a high incidence of it in the South. The belief is held that if a large number of supposedly normal school boys were subjected to X-ray examination, a proportion of them would show the disease. As the cases in this series are evenly distributed through the highest and lowest social or-

ders, no conclusion can be drawn except that it is much more common in boys than girls. The fact remains that, while it is well known to roentgenologists, but few of the better informed general practitioners have ever heard of it.

The symptoms of this condition are so well marked that there is little difficulty in making the diagnosis. As this is a lesion of the epiphysis, obviously it can begin only between the time the tuberosity appears and the time at which it unites with the tibia (21), namely, between the ages of twelve and twenty-one in the average case, although it is well known that various systemic diseases can interfere materially with the timing of epiphyses. There is almost always a history of slight injury, such as a kick on the tubercle, a fall on it, a sudden strain sustained from a jump as in diving from a spring-board, or a sudden lifting from the stooping position to the erect. The pain continues and is severe—out of proportion to so slight an injury—and by the time the patient seeks medical attention there is swelling, redness, local heat, and extreme tenderness. At this time the radiograph is essential to confirmation and both knees should be filmed for comparison, although a bilateral condition is often seen, one side giving no clinical symptoms, with similar roentgen findings. It is possible that there may be a bursitis closely simulating Osgood-Schlatter's, but the roentgen findings would be negative in the case of the bursitis.

The true pathology is not known, for, although several cases have been operated on, no record is found of any microscopic studies. The following have been given as causes: faulty development, endocrine dysfunction, infection, tuberculosis of the epiphysis, rickets, and simple trauma.

¹Read before the Radiological Society of North America, at Chicago, December 6, 1928.



Fig. 1, Case 1. A comparison of new and old films: note the resolution.

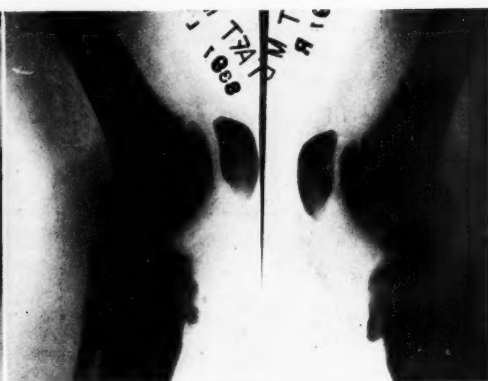


Fig. 2, Case 4. Left knee shows typical findings of Osgood-Schlatter's disease: right is negative.

The author believes that it is purely traumatic in origin, although the trauma may be so slight as to escape notice. In all probability it originated at some slight injury which the patient failed to notice and was not recognized until another more severe injury brought it to notice. The following is possible, though not likely: The regular process of a non-infective osteitis sets in (22), namely, an infiltration of leukocytes into the perivascular spaces, which, on account of the unyielding nature of the

surrounding tissue, blocks the vessels by pressure and leads to thrombosis, with subsequent necrosis.

The author believes that the description which follows accounts for the condition completely. The sudden strain or injury causes a partial pulling loose of the patellar ligament from the tubercle, and, as the patient continues to use the leg for some time, there is a constant irritation, with the resultant stimulation of osteoblasts. As a result of the motion the bone is not laid down

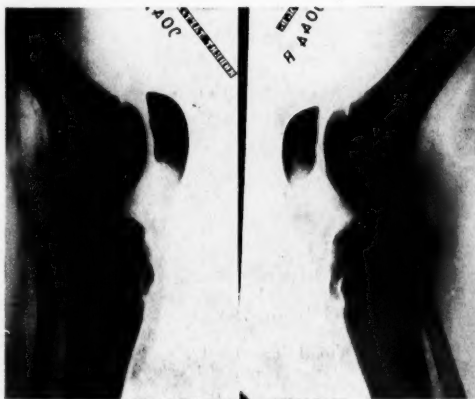


Fig. 3, Case 5. Left knee shows typical findings of Osgood-Schlatter's disease: right is negative.

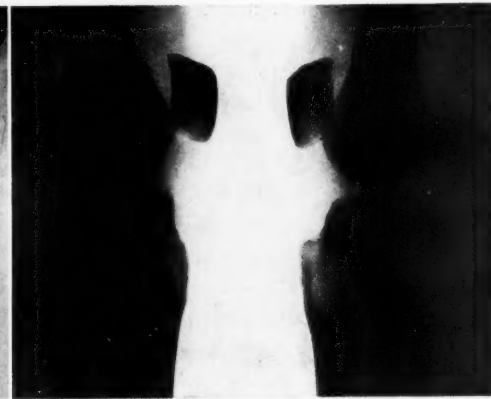


Fig. 4, "extra case" (see Table I). Man, 31 years of age, who undoubtedly had Osgood-Schlatter's disease bilaterally when a boy. Note the marked production of bone at the tibial tuberosities.

evenly but in small spots, which gives rise to the ragged appearance as seen on the radiograph.

The form of resolution shown is that of any other osteitis, as is shown by the following case report.

A physician, age 31, on hearing a discussion of this disease realized that he had had the condition when a boy of fourteen. It was diagnosed at that time as a bursitis and not treated. After several years it cleared up, leaving no tenderness but a marked enlargement of the tubercles. A radiograph taken at the time of discussion of the case (Fig. 4) shows the increase of bony production, which is exactly the way in which we should expect it to heal. This information cannot now be substantiated, but is highly probable.

In regard to treatment, in the author's series, simple splinting has been all that the attending physicians have used, and in some cases elastic web bandages, which are not satisfactory, or leather cuffs. No surgery has been necessary on any of the cases of this series, but in some cases of other authors the tubercle has been curetted or a bone peg used to anchor the patellar ligament (7) (11). Most of the patients have gotten on well, but a few still have pain on exertion.

As all of the cases ran so nearly similar a course, detailed report of only one is given.

On November 20, 1927, a boy, J. T. (Table I, Case 4), fifteen years old, was brought in for radiographic examination of the left knee. He was the son of a physician specializing in eye, ear, nose, and throat practice. His father and mother were in perfect health as were several brothers and sisters, none of whom had had any similar trouble. The past history was essentially negative—nothing to indicate rickets, lues, or tuberculosis, and at the time of examination he appeared a healthy, well

developed, active boy. While playing school football, he had been tackled and was thrown on the knee. The knee became swollen, and quite tender. A bilateral radiograph showed the right knee and tibial tubercle normal for a boy of this age. On the left there was the ragged, moth-eaten appearance of Osgood-Schlatter's. A surgeon who was called in was finally convinced that there was such a disease entity. A stiff leather cuff about fourteen inches long was worn for several months, at the expiration of which time the pain had subsided. Radiographs made in February and May, 1928, showed little change in the appearance, but at present (October, 1928) the clinical symptoms are practically negative although there is slight pain on exertion.

For information concerning other cases, see Table I.

SUMMARY

Osgood-Schlatter's disease is an epiphysitis of the tibial tuberosity, pre-existing, but accentuated by a moderate injury. It is not associated with any other disease. Splinting is the only treatment needed in most cases. It is not so rare as is generally supposed, but often escapes notice.

Eight new cases and one old one are reported in this paper.

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TABLE 1

Case No.	1	2	3	4	5	6	7	8	Extra
Age	14	15	16	15	14	18	16	16	14
Sex	M	M	M	M	M	M	M	F	M
Race	W	C	C	W	W	C	W	W	W
Leg Involved	Right	Right	Right	Left	Left	Both	Both	Both	Both
Economic Condition	Good	Poor	Poor	Good	Good	Poor	Good	Good	Good
Injury	Kick	Fall	Struck by Auto	Football	Fall	None	Strained Lifting	None	None
Severity of Symptoms	Severe	Mild	Mild	Severe	Severe	None	Slight	None	Mild
Treatment	Elastic Web	None	None	Leather Cuff	Elastic Web	None	None	None	None
Results	Fair	Good	Fair	Good	Fair	Too new to state			Good
Special Features			Blind in one eye since childhood, probably a gonorrheal opthalmitis			Tuberculous knee; Schlat-ter's found ac-cidentally			Age 31 now

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THE VALUE OF RADIATION THERAPY IN THE POST-OPERATIVE TREATMENT OF PAPILLARY CYSTADENOMA OF THE OVARY¹

By W. A. NEWMAN DORLAND, M.D., F.A.C.S., CHICAGO

CYSTIC growths of the ovary are very common. In fact, there is no other organ in the human body which is so prone to cystic changes as is the ovary. For the most part, these ovarian cysts are benign; once removed, there is no tendency to recurrence. The patient is cured of her disease.

There is one variety of ovarian cyst, however, which, while not malignant in the sense of malignancy as associated with sarcoma and carcinoma—that is, not producing secondary metastatic growths in various regions of the body—is to be regarded as semi-malignant in that it does show a decided tendency to recur *in situ*. This is the so-called papillary cystadenoma of the ovary, a specimen of which I show you at this time (Fig. 1).

This papillary ovarian cyst occurs in two distinct forms, namely, the *inverting* and the *everting* types. By far the most common form is the inverting cyst, that is, a cyst lined on its inner surface—the surface proximal to the cystic contents—with numerous papillary outgrowths. The everting variety is quite rare, that is, the form in which the papillary growths are on the outer or external surface of the cyst-wall, in direct contact with the adjacent pelvic viscera and tissues, as is seen in the specimen I have presented. Naturally, such a growth is more dangerous to the patient from the standpoint of recurrence than is the inverting variety. Indeed, the latter form becomes dangerous only when punctured or ruptured, either accidentally or at the time of operation, permitting an escape of the papillary growths into the free peritoneal

cavity, where they multiply over the entire peritoneal surface.

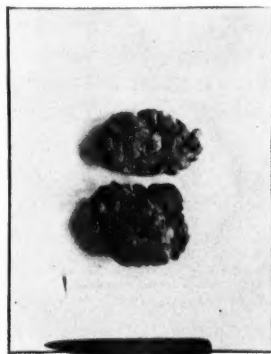


Fig. 1. Bilateral everting papillary cystadenoma of the ovary.

THE STATISTICS OF PAPILLARY OVARIAN CYSTADENOMA

A few clinical facts bearing upon papillary ovarian cystadenomata may be interesting as showing the frequency and course of the tumors. Of all ovarian tumors, cystic and solid, the papillary cyst comprises about 19 or 20 per cent (Erdmann and Spaulding), and of all cystic ovarian tumors it comprises from 16 to 18 per cent (Mayfield). I do not know of any statistics showing the frequency of the everting type of the disease as compared with the inverting type. The average age at which the growth appears is 47.6 years (Mayfield); it is most common in multiparous women of from 45 to 55 years of age (Schwartz), but it may be met with in children, or even after 70 years of age. Kelly and Sherwood report three cases in old women; and, according to Wiel, 8.4 per cent of the cases have occurred in children. I think Wiel's

¹Read at the Annual Meeting of the Radiological Society of North America, at Chicago, December 3-7, 1928.

percentage is higher than is shown by the experience of other operators.

There is some uncertainty as to the origin of the papillary cyst, but it is the consensus of opinion that it probably springs from certain epithelial structures derived from the germinal epithelium. It is frequently a bilateral condition. Mayfield, in 100 cases, found bilateral growths in 43 of the women; Ewing states that it is bilateral in 60 per cent of the cases. As you will note, the condition was bilateral in my patient. Implantation-growths may occur at some point in the peritoneal surface in the everting type, and after rupture or perforation of the inverting type. Recurrence of the growth after surgical removal is quite common. The average interval before recurrence takes place is one year and eight months, but the recurrence may be noted as early as two months, or the tumor may not reappear under ten years.

HISTORY OF THE CASE

On October 22, 1927, I operated on the woman from whom the specimens shown in Figure 1 were removed. This patient was 49 years of age and had been married 19 years. She had never given birth to a child, but she had had two miscarriages of about two or three months' development each. She had suffered from but vague symptoms—some pelvic discomfort, a bearing-down sensation, but no pain, and a degree of vaginal prolapse. Digital pelvic examination revealed a very nodular and irregular mass, resembling a muskmelon to the touch, which lay behind and to both sides of the uterus. This mass was fixed and was somewhat sensitive at spots. A diagnosis of cancer of the ovaries had been made by her physician.

The operation revealed the tumors I have shown you, which microscopically were found to consist of numerous "stalks" or projections of dense fibrous stroma arising

from a central solid fibrous core. These were lined with one or two layers of small epithelial cells. The line of demarcation between the lining epithelium and the fibrous stroma was well preserved, and there was no tendency to invasion of the stroma, *i.e.*, there were no carcinomatous characteristics. The cyst-wall was composed of ovarian stroma containing areas of hemorrhage and round-cell infiltration. A diagnosis of bilateral papillomatous ovarian cystomata was made, and, owing to the marked tendency of such tumors to recurrence *in situ* in the form of implantation-growths, the patient was given a prolonged course of X-radiation by Dr. M. J. Hubeny. At this time, thirteen months after the operation, there are no signs of recurrence.

VIEWS ON THE VALUE OF RADIATION THERAPY IN OVARIAN MALIGNANCY

Based upon the theory that these papillary cysts of the ovary, if not malignant in the true sense of that term, are to be regarded as semi-malignant in that they are very prone to recur in the pelvic or abdominal peritoneum, it is customary to give the patients the presumptive value of irradiation to prevent such recurrence. Just what the actual value of this post-operative treatment is has not as yet been determined, though it is possible that a reference to the published opinions of the abdominal surgeons may aid us in arriving at some definite conclusion as to the matter.

Unfortunately, as Lape (1924) has indicated, the roentgen-ray treatment of papillary ovarian cysts is mentioned but very little in the literature. He thinks that this may be due to the fact that these growths are considered as purely surgical, or because they do not occur very frequently. Personally, he believes the roentgen-ray treatment has a distinctly beneficial effect. Ford (1928), of the Mayo Clinic, has made the most complete study to date of the subject,

with a review of the literature. It is interesting to note that what few references are to be found vary remarkably in their opinion as to the value of the treatment.

Thus, Codman (1918) was successful in preventing recurrence in two cases out of five; while Orbaan (1920) reported eleven cases of ovarian carcinoma treated by radiotherapy, half of the cases being benefited and a permanent cure being noted in one case.

Walthard (1920) had phenomenal success with irradiation in two cases of ovarian carcinoma, no recurrence being noted after three and a half and six and a half years, respectively.

Stacy (1922), in discussing the treatment of non-malignant tumors of the pelvis, claims that ovarian tumors constitute a contra-indication to radium treatment. She may or may not have included ovarian cysts in this group.

In a summary of a report of his experience in the London Radium Institute, Hayward Pinch (1922) includes ovarian cysts in the class for which radium is useless, but mentions the roentgen ray as preferable for some conditions, including cystic disease of the ovary. In this connection, he states: "With regard to cystic conditions in general, radium treatment is of little value, more especially if the cyst be large and tense. When favorably situated, however, removal of the contents of the cyst by incision or aspiration, followed by the introduction of radium into the cyst-cavity, may be utilized to induce inflammatory adhesions of the cyst-walls and so prevent its reappearance."

Strassman (1922) regards irradiation as valuable in direct proportion to the size of the tumor removed surgically.

Wood (1923) reports that in the post-operative treatment of papillary adenocarcinoma of the ovary the symptoms were abolished in a number of cases for a long time following the use of large doses of roentgen

rays, while in other cases in which the tumors were morphologically similar death occurred within a few months, with extreme peritoneal involvement despite irradiation.

Norris and Vogt (1925) claim that post-operative irradiation in these cases, either with radium or X-rays, was always unsuccessful; while Holmes and Dresser (1926) state that the relief afforded by irradiation was temporary only.

Dreuschuck and Lovas (1925) had marked success in two cases of inoperable carcinoma of the ovary with extensive metastases, but they call attention to the fact that severe reactions and bad results occasionally follow irradiation.

Mayer (1926) recommends deep X-ray therapy or radium as a prophylactic measure, adding that if the fluid is spilled during operation, deep radiotherapy is indicated at once, that is, after six weeks.

Phillips (1926) found that while the symptoms of ovarian carcinoma subsided completely after irradiation for a varying period, the growth subsequently recurred with a fatal termination.

Döderlein (1927) admits the uncertainty of the curative effects of irradiation used post-operatively, but urges its use in all cases.

Mayfield (1927), of the Mayo Clinic, states: "It is generally agreed that, if the growth has been incompletely excised, the patient should be given the benefit of roentgen-ray and radium treatments because of the sensitiveness of ovarian tissue to irradiation and the relatively low degree of malignancy of these tumors."

Holzman (1927), who reported a papillary cystadenoma of the ovary in a girl of thirteen, used radium and X-ray before operation, the mass remaining stationary in size under this treatment for a period of seven months, after which time there occurred a gradual growth of the tumor. He then operated, removing all of the cyst except an implantation-growth on the omen-

tum, which was subsequently treated by radium and X-ray. In this case, the radiotherapy was given in doses of 200,000 volts, 5 milliamperes, 50 cm. distance, 15 cm. square field, with filtration of three-fourths millimeter copper and 1 millimeter aluminum. The treatments lasted for 75 minutes each, through right and left abdominal portals and one central posterior portal, giving a total of 375 milliamperes-minutes in each of the three areas. The radium was used through drainage tubes in about equal amount for a total of 6,558 milligram-hours. Under this treatment there was a temporary retardation of the growth.

The dosage recommended by Lape (1924) was 110,000 volts by sphere gap reading, 5 milliamperes, 12 inch skin target distance of 3 millimeters, with aluminum filter, with 12 minutes' exposure over each one of several areas covering the lower abdomen from the front, back, and sides.

Keene, Pancoast, and Pendergrass (1927) advise the use of irradiation as a prophylactic measure in all cases after surgical removal.

Ford (1928), of the Mayo Clinic, summarizes 59 cases of ovarian carcinoma treated by irradiation at the Clinic and states that "the number of patients alive between four and seven years after operation compares favorably with the number mentioned in available reports of the results of surgical procedures alone." She adds that "considerable palliation may result even in far advanced cases from the judicious use of radium and roentgen rays," in carefully graded doses.

CONCLUSION

I have presented this comparatively rare case of ovarian neoplasm before this Society in the hope that it may elicit a free and open discussion on the value of deep radiation therapy in malignant and non-malignant conditions of the abdomen and pelvis. As we have seen, there is a wide divergence of opinion as to this matter, able physicians aligning themselves on both sides of the question. I believe it will be both interesting and valuable at this time and place to obtain a frank expression of opinion, with reasons for the belief, both for and against deep radiation therapy of the body-cavities.

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THE MANAGEMENT OF CARCINOMATA OF THE UTERI CERVIX¹

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FIRST, I wish to express my appreciation for having been invited to take part in this symposium on radiation therapy in gynecological diseases. In this presentation the plan of management, together with the technic of the application of roentgen rays and radium will be stated as applied to the management of carcinomata of the uterine cervix by me. At the end of the paper the results obtained by the treatments about to be described will be given briefly.

So much has appeared during the past few years from many authors on the scientific application of radiation according to physical measurements, that perhaps a paper in which the clinical conditions encountered are equally emphasized may not be out of order. Correct irradiation cannot be applied, of course, without making use of the investigations of the physicist; however, the clinician must determine the indications for treatment in the individual case, considering the patient's general condition, and the results obtained by the application of the treatments advised. With these thoughts in mind this paper is presented, with the hope that it may be of some help in keeping before us the proper relationship or balance between the laboratory and the clinical aspects of the subject.

CLINICAL CLASSIFICATION FOR TREATMENT BASED UPON EXAMINATION

The preliminary examination to determine the extent of the newgrowth is carried out bimanually and, by the use of a speculum, by sight. Upon the basis of this ex-

amination the cases are classified according to the Schmitz grouping (1) presented in 1920.

CLASS I. The carcinoma is clearly localized within the cervix and there is absolutely no fixation of the genital organs.

CLASS II. The carcinoma has extended so that the entire cervix is involved and the tissues about the cervix feel boggy.

CLASS III. The carcinoma has extended to the extra-cervical tissues, one or both parametria being involved, or definite metastasis to the pelvic lymph nodes has taken place.

CLASS IV. The carcinoma has involved the pelvic tissues to such an extent that there is absolute fixation of the genital organs; the patient is said to have a "frozen pelvis"; there is cachexia, etc.

CLASS V. The carcinoma has recurred and is classified under the first, second, third, or fourth group, as above, according to the extent of the involvement present.

Clinically, carcinomata of the uterine cervix occur in three groups:

1. Those that spring from the vaginal surface of the cervix (2).
2. Those that begin in the cervical canal.
3. Those that involve both the vaginal surface and the canal when first seen.

Carcinomata of the uterine cervix are also classified clinically as:

1. Everting, *i.e.*, those of the cauliflower, papillary, and proliferating types;
2. Inverting, *i.e.*, those of the infiltrating, nodular, ulcerative, and parenchymatous types.

A rectal digital examination is always made to determine the condition of the lymph nodes located at the bony pelvic girdle and

¹Read before the Radiological Society of North America at the Fourteenth Annual Meeting, at Chicago, Dec. 3-7, 1928.

the parametria. Often it is advisable to examine the lower sigmoid and rectum with the endoscope in order to define the damage to these parts by extensions of the disease.

If there are any symptoms other than those of pressure from the urinary bladder, in addition to the routine urinalysis, the organ must be explored by the cystoscope. In spite of the fact that a patient must be treated regardless of the condition of her other vital organs, it is always well to have the various functional tests made, together with blood chemistry examinations, so that unexpected complications may not arise during the course of treatment. Such examinations are of value from the prognostic standpoint likewise.

The majority of cases treated already have had a biopsy. Those referred for diagnosis and advice or treatment, as the case may be, have sections taken by surgical diathermy. Surgical diathermy is used for this because we feel that it is a little safer. Some authorities, as you know, state that there is no danger in taking sections; others, that mechanical metastasis may be produced by such diagnostic procedures. In any event, the patient is certainly entitled to every procedure that will in any way increase her chances for ultimate recovery. Removing sections by surgical diathermy can be done with almost no trauma; the tumor does not have to be caught and held by some crushing instrument; the current seals the cut vessels, both blood and lymphatic, for which reason there is no bleeding. Therefore, by this method whatever possibility there may be of producing a fatal metastasis is reduced to a minimum.

HISTOPATHOLOGY

Carcinoma springing from the vaginal surface of the cervix is the variety with which we most frequently meet. Such a newgrowth arises from the squamous epithelium covering the mucous membrane and is known as a squamous cell carcinoma.

Adenocarcinoma begins within the cervical canal from one of two sources: (a) from the cylindrical epithelium covering the cervical canal, or (b) from the glands of the cervix.

Histopathologic studies may also determine the degree of malignancy in the individual case. According to Broders, the cases fall into one of four groups, Group 1 being the least and Group 4 the most malignant. This grouping is of great importance to the clinician in his selection of cases for treatment.

Should the preliminary examination show that the newgrowth is associated with infection (advanced cases, together with a considerable proportion of early ones, are always infected), this must, of course, be remedied before anything locally can be attempted with safety. Douching with saline or mild antiseptic solutions and the use of autogenous vaccines will eradicate all of the ordinary organisms, including those of the staphylococcal and streptococcal varieties, except the *Streptococcus hemolyticus*. This most dangerous of the organisms found associated with carcinomata of the cervix will, however, resist such treatment. Witherbee has observed that hemolytic streptococci disappear from irradiated tissues by the second week following treatment, a statement which has been confirmed in our experience, because the treatment about to be described always begins with roentgen irradiation, and to date there has appeared no severe infection or death due to the *Streptococcus hemolyticus* following localized procedures, in spite of the fact that the organism may have been present before preliminary roentgen irradiation.

PRELIMINARY ROENTGEN IRRADIATION

Since it is almost a constant observation that patients do not die of malignancies until the disease has metastasized to nearby or distant tissues or vital organs, and since

there is no treatment or agent that can compare in efficiency with thorough, correctly applied roentgen rays in the eradication of malignant disease involving tissues or organs about primary lesions, or in preventing such tissues and organs from invasion by malignant extensions, the treatment always begins with roentgen irradiation. Wertheim, during many of his radical hysterectomies, was surprised to find that in all of the cases which appeared to be very early ones, one-third already had metastasis to the pelvic lymph nodes. Also, we have all seen beautiful local radium results, yet the patient apparently was not improving, and eventually death resulted from malignant extensions which could not be efficiently radiated with radium alone from its application within the cervical and uterine canal. Further, the laboratory observations of many, that irradiated tissue either does not permit transplanted malignant cells to grow or that they grow with difficulty, and that irradiated malignant cells either do not grow or grow with difficulty when transplanted, would appear to indicate that not only the tissue actually involved by the disease, but all of the tissues and organs within reasonable limits, ought to be thoroughly radiated. It is a practical impossibility to reach all of the pelvic organs and tissues with radium rays in efficient quantities; therefore, during the past eight years no case of carcinoma of the cervix has been treated with radium alone. The roentgen treatments, for reasons already stated, are always given first, and the results have improved in accordance with the improvement in the technic of roentgen irradiation.

TECHNIC OF ROENTGEN IRRADIATION

The preliminary roentgen treatments are planned so that they will be completed within two weeks' time, with not more than eight to ten days actually consumed in the treatments. The number of ports of entry

varies from five to nine according to the size of the patient's pelvis. They are taken from the lower abdominal region, the sacrogluteal region, from the lateral aspects of the pelvis, and from the perineum. Generally in this two weeks of preliminary roentgen treatment each port of entry is treated twice with rays generated at a voltage of 200,000, the focus skin distance being 50 centimeters, the filter 0.5 mm. of zinc plus 3 mm. of aluminum, 37 per cent of such rays reaching a depth of 10 centimeters. The time duration of each treatment varies directly as the size of the pelvis varies in individual patients, so that from two hundred to two hundred and fifty milliamperes-minutes is the applied dosage to each port of entry. The number of ports of entry, taken together with the time duration of the treatment over each, is so planned that not less than 170 *e*-units dosage will actually be applied to the cervix, uterus, and pelvic organs and tissues by the total irradiation from all ports.

CLINICAL CONDITIONS FOLLOWING PRELIMINARY ROENTGEN IRRADIATION

Often, even in the most desperate cases, there is a marked change in the clinical condition of the patient. She is generally happier and has a more optimistic outlook, because usually the hemorrhages have disappeared, sometimes even there is no bloody streaking, discharge has decreased, and not infrequently all pain has disappeared. Conditions, in general, are almost always much improved and the patient comes up for local treatment not later than one week following the last day of the preliminary roentgen treatment.

Examination often shows an improved local condition even at this early date, cases that have had the most evidence of infection associated with the malignancy showing the most striking results. Not infrequently a newgrowth that appeared to involve the cer-

vix, with extensions to other parts, has receded so that only the cervix is actually involved. The apparent malignant extensions of the disease would seem not to have been actual, in such an instance, but proved to be only the products of an extensive pelvic infection grafted onto the malignancy. The malignant tissue itself may also show the effect of the treatments in that it may not bleed so easily. The field can be kept comparatively free from blood and under such conditions more accurate, efficient local treatment can be carried out by the operator.

ELECTROTHERMIC SURGERY

At one sitting, with the patient under gas and oxygen anesthesia, the newgrowth as manifested by cauliflower-like findings, papillæ, proliferations, infiltrations, nodulations, ulcerative conditions, etc., is destroyed and removed by electrothermic coagulation. Care is taken to place a coagulated wall—if possible well out in the tissues surrounding the disease which appear to be healthy. Then the disease itself is destroyed and removed, the coagulation being continued until there is a coagulated base beyond what was the deeper extensions of the disease—sometimes even the entire cervix is destroyed and removed by this method. Your essayist has described the exact technic of electrothermic surgery elsewhere, and since the advantages of this method of operation as compared with any and all of the older methods are so well known to all cancer workers, the discussion on this topic will end here because this paper is already too long.

RADIUM THERAPY

Radium treatment is begun as soon as the electrothermic operation just described is completed; in fact, it is done under the same anesthetic. Special applicators, made to fit the individual case, are placed within the cervical and uterine canal, without dilatation, if possible. The capsules are placed

in tandem, so that the entire uterine canal, from fundus to cervical stump, is filled. Occasionally one capsule will accomplish the desired result; generally, however, two or three must be used, and sometimes even four capsules may be necessary. The amount of radium in each does not often exceed fifteen or twenty milligrams. This small amount of radium is generally used so that a prolonged treatment can be given safely. The advantage of using a comparatively small amount of radium for a long period of time, as compared with using a large amount of radium for a shorter time, the same total dosage being applied in each instance, is, as you know, a very important one. Malignant cells are easiest to destroy when undergoing mitosis. All of these cells do not divide at the same time. Therefore, with the longer time duration of the radium treatment, even though the dosage is not exceeded as compared with the same dosage obtained with a larger quantity of radium applied for a shorter time, the results obtained under the former conditions will be much better than under the latter conditions. The radium treatments, therefore, follow closely the suggestions of Regaud (2), of the Radium Institute of the University of Paris. However, occasionally there appears to be an indication for the use of much larger quantities of radium, and under such conditions as much as 200 milligrams have been applied in one case. The filter for the radium is 2 mm. of brass plus 1 mm. of aluminum. Lastly, the vagina must be ballooned with gauze.

It is our purpose to complete the radium treatment with one application. Less than 1 per cent of our cases have had two exposures to radium. With radium used in such small quantities and distributed over such large areas, it can safely be left in place for from three to five days. In such treatments the dosage averages about five gram-hours, although three gram-hours only may be indi-

cated in some instances, whereas in others as much as seven gram-hours have been given.

POST-RADIUM ROENTGEN IRRADIATION

In from two to three weeks following completion of the radium treatment just described, *i.e.*, in four to five weeks following the last of the preliminary series of roentgen treatments, further roentgen treatments are given in the manner already described under "Preliminary Roentgen Irradiation." These are completed within two weeks, giving a total roentgen irradiation over each port of entry of from eight hundred to one thousand milliamperere-minutes, or nearly three erythema doses, without at any one treatment ever approaching an erythema. The skin is, however, deeply tanned by such treatment.

With such a combination of roentgen and radium treatments it is felt that you will agree that the patient is kept well saturated with radiations for a period of about twelve weeks; in fact, the treatment given is probably as thorough as is applied anywhere by anyone. Carrying on further with the suggestions already made for radium treatment, all of the roentgen treatments are given with a low milliamperage, which, of course, makes this method of treatment a tedious one for all concerned. The average total machine treatment hours are twenty-eight, which figure approaches the total number of treatment hours employed by Fürst at the Gynecologic Institute of Zurich University (3), whose average is forty hours.

PROGNOSIS

No cure can, of course, be absolutely promised in the treatment of any malignant disease, no matter where it may be located. Carcinomata of the uterine cervix are highly malignant and, before the days of roentgen and radium therapy and electrothermic surgery, even with the Wertheim operation,

if the patient did not die of the operation she was almost sure to die eventually of the disease. However, in general, under the methods of treatment herein advised, the older patients usually do better than the younger ones. Patients afflicted with carcinoma of the everting type generally experience better results than those suffering with the inverting type of the disease. Carcinomata springing from the vaginal surface of the cervix, *i.e.*, those of the squamous cell type, while they are somewhat more difficult to influence with radiation, give the better end-results. Once they have been cleared up, the result is more likely to be permanent. Carcinomata springing from the canal of the cervix, *i.e.*, those of the adenocarcinoma type, metastasize easily, and, while they are more easily influenced by radiation, the results obtained are not nearly so likely to remain permanent.

It is impossible to overestimate the value of the studies of Broders and Schmitz (4) regarding the prognostic importance of the histological malignancy index. Cases of the first two groups, if not in an advanced condition when first seen by the physician, have very good chances for the disease to be arrested; those of the third group have a chance for recovery, while those of the fourth group are practically hopeless from the very beginning. However, from the standpoint of the clinician the Schmitz plan for grouping the cases is invaluable, because the results of the treatments are in direct proportion to the number treated and the stage of the disease found at the time active treatment is instituted.

RESULTS

At the Mayo Clinic it is felt, and the opinion has been expressed, that in its early stages carcinoma of the cervix is so easy to eradicate by means of radiotherapeutic procedures that little else is necessary, other than the indicated medical measures; where-

as, later on in the course of the disease, no other method of treatment can hope to accomplish anything. The absolute truth expressed in this one sentence is borne out in the daily practice of many. An average of fifty cases is treated each year in my clinic. The percentage of arrested cases for five years in the various groups, according to the Schmitz plan for clinical classification, is: Group I, 84.0; Group II, 42.0; Group III, 19.0; Group IV, 0.

CONCLUSIONS

1. In the early paragraphs of this paper considerable clinical data are given, including the clinical classification for the study of malignant diseases of the uterine cervix; the pathologic types encountered are enumerated, together with the site of the primary lesions of the various types, and the pathologic histology is reviewed.

2. The methods of eradicating infections associated with malignancies of the uterine cervix are outlined.

3. The plan and technic of roentgen and radium therapy are given at some length. Electrothermic procedures are mentioned, and advised.

4. Clinical conditions following preliminary roentgen irradiation are described.

5. The prognosis and results obtained by the plan and technic of the treatments advised are given.

6. From the discussions included in the other papers in this symposium, together with those presented in this paper, it can undoubtedly be concluded that the treatment of carcinomata of the uterine cervix with roentgen rays, radium, and electrothermic surgery is past the experimental stage; that the plan and technic of treatment are rapidly becoming standardized as shown by the agreement of the various authors, and that no other method of treatment to date has even approached the results obtained by those of us who are engaged in the radiation treatment of this malady.

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STANDARDIZATION OF X-RAY AND RADIUM TREATMENT OF CARCINOMA OF THE CERVIX¹

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IN this country, within the past few years, the treatment of carcinoma of the cervix has been removed from the field of surgery and transferred to the field of radiotherapy. Surgery in the treatment of this disease is now almost a matter of history. The responsibility for the treatment of cancer of the cervix uteri now rests squarely upon the shoulders of the radiologist.

The reaction of radiology to the added weight of this responsibility has hardly been entirely satisfactory: there has been no successful attempt to come anywhere near a standardized method of procedure in these cases. A review of the literature reveals a most discouraging conglomeration of conflicting opinions. Occasionally two authors are found who nearly agree, but one is always tempted to say, "as many men, as many methods." One believes that radium is the sheet anchor, and has never seen any good results follow X-ray treatment. Another, that in all but the earliest cases a thorough course of X-ray treatments should be given before radium is added—he does not say how long before. One believes the best method in borderline cases to be full dosage of radium, to be followed immediately by complete hysterectomy. Another agrees to the radium but advises a wait of five weeks before the complete operation. One advises a massive dose of radium in the beginning, never to be repeated, and another advises small doses of radium frequently repeated until the patient rebels—and then resort to the X-ray. Some believe in radium and others believe in the X-ray—as if

this were a matter for belief rather than for knowledge and reasoning! And so it goes.

In the *Southern Medical Journal* for April, 1928, was published an article entitled "Giving the Uterine Cancer Patient the Best Chance to Survive," in which the author devotes eight pages to his best method of giving radium and at the end of the article devotes about eight lines to X-ray treatment. If the amount of treatment is in proportion to the amount of print, it might be questioned whether he is giving his patient the best chance to survive. Dr. A. C. Primrose reports results of treatment by radium of 429 cases of carcinoma of the cervix uteri, in the *Journal of the Medical Association of Georgia*, May, 1926. These cases were treated at the Howard A. Kelly Hospital, Baltimore. No mention is made of any of them receiving any external radiation by either X-ray or radium. Small wonder that the percentage of five-year cures was only 13, and that only 8½ per cent of all the inoperable cases were cured. Why should 429 unselected cases of carcinoma of the cervix be treated by radium (internal radiation) only?

Maurice Lenz, writing in the *American Journal of Roentgenology and Radium Therapy* for March, 1927, says in an article on "Radiotherapy of Cancer of the Cervix at the Radium Institute, Paris, France," that all but the earliest cases receive both X-ray and radium, and think it very important that the course of X-ray therapy should be given first. Doses of one hour's duration of heavily filtered X-ray should be given twice a day for from ten to twenty-five days. This external radiation is followed by five to seven days of almost continuous application of small quantities of

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radium within and against the cervix. Here, indeed, is a different method.

Underlying all of this mass of confusing statement and opinion let us hope that there is running a vein of truth and certain facts and principles upon which may be formulated a method of applying radium and X-rays in carcinoma of the cervix superior to any of the methods so far advocated by any individual radiologist. If such a method could be formulated, then would the radiation treatment of this disease be fairly well standardized. This would not mean that all cases would receive the same treatment. It would probably mean that each of the three classes, early, borderline, and advanced, would be treated in accordance with certain principles which apply to the class in question. It would probably mean that the treatment of several hundred unselected cases by internal radiation alone is indefensible. There are a number of radium owners who treat all cases by radium only. Most of these must think that they are doing right, though I think the contrary can be rather clearly demonstrated both by theory and by recorded results.

Before a reasonable standardization can be arrived at, there are certain points about X-rays and radium rays that need clarification. Most doctors in general, many radium owners, and a few radiologists still believe that there is a difference in the response offered by living tissue to gamma rays and to high voltage X-rays. They still have a lingering impression that one is one thing and the other is another—that one is better than the other. If you think this is extreme, refer to the article quoted above from the Radium Institute, Paris. Therein it is stated that if a malignant lesion either of the skin or of the cervix be treated first by radium and then by X-rays, healing will not take place, whereas if X-ray treatment is given first and followed by radium, healing will occur in practically every case.

Cases are cited in attempt to prove this statement. The author evidently fully believes that there is a difference between the physiological effect of gamma rays and X-rays of nearly the same wave length. I think we may state without fear of contradiction that the author's position is untenable, and that if a given amount of living tissue be subjected to a given amount of radiation by gamma rays or comparable X-rays, then the tissue response will be the same in either case—provided only that the source of the X-rays and the source of the gamma rays be placed at equal distances from the surface of the tissue in question so that the distribution of the rays within the tissue shall be the same.

And this brings us to a second point which is in great need of clarification, namely, that the distribution in the tissue of the rays from radium as used, is vastly different from the distribution of rays from an X-ray tube. To illustrate: suppose a capsule of radium be laid upon the skin, the distance of the radium element from the skin will be about 2 mm. Allow the capsule to remain *in situ* long enough to give a double erythema dose to the upper layer of the skin, causing death and sloughing of the epidermis. A point 2 mm. below the upper surface would receive only one-fourth as much as the surface, that is, one-half of an erythema dose, while the lower layers of the skin and the subcutaneous tissue would not be injured to any extent. But if the same surface dose were given with an X-ray tube at a target distance of 50 cm., that is, 500 mm., then a point 2 mm. below the surface, or 502 mm. from the target, would receive nearly the same dose as a point on the surface, and a dose sufficient to cause sloughing of the epidermis would also cause sloughing of the whole thickness of the skin and some of the subcutaneous tissue. Here is an apparent difference in effect. It is not, however, a real difference, but a difference

brought about solely by the difference in distribution of the rays within the tissue.

And this, in turn, brings us to a third point, which needs, if not clarification, at least accentuation: Radium as we use it at present in quantities of 50 or 100 mg. is a very feeble source of radiation. One hundred milligrams of radium filtered through 0.5 mm. of silver, 1 millimeter of brass, and 1 millimeter of rubber, laid upon the skin will produce an erythema in two hours. The radium itself is 2.5 mm. from the skin. The X-ray as ordinarily used in deep therapy would, with the same filtration, produce an erythema in the same time—two hours, but the source of the rays in this case would be 50 cm., or 500 mm., from the skin. The distance is two hundred times as great for the X-ray as for the radium. The square of 200 is 40,000. This means that the beam of X-rays as ordinarily used in these cases is forty thousand times the intensity of the beam of gamma rays from 100 mg. of radium.

There is a certain percentage of error in the result of this calculation owing to the fact that radium rays are not point radiation. Granting an error of even 50 per cent, we still have a ratio of 1 to 20,000.

Now in order to get an adequate amount of radiation from a feeble source within a reasonable time limit, it is necessary that the source be placed very near to the point where the radiation is required, just as in order to read by a very feeble light we must come very close to it. On this account, then, radium is a close-range weapon. In spite of its extreme penetration, its zone of active influence is quite limited, nor can it be made to actively influence tissue somewhat remote from the tissue against which it is placed. Its distribution is in accordance with the law of inverse squares, and if it be left *in situ* long enough to actively influence tissue somewhat remote, it will in that time cause necrosis of near tissue.

On the other hand, the beam of X-rays is of such volume that in spite of distance reduction, an adequate dose may be given within a reasonable time limit. By giving this dose through a number of ports of entry, a dose of any required amount may be built up within the pelvis. The X-ray, then, is a long-range weapon and furnishes the only practical way of administering to the whole pelvis radiation of sufficient intensity and uniformity to kill radiosensitive malignant cells which may have found their way to some part of the pelvis quite remote from the original site of the disease.

Consider the application of these observations to the actual placing of radium within the cervix. Radium as commonly used in a brass capsule covered by rubber is about 2.5 mm. from the living tissue of the cervical canal. It is quite obvious that the tissue in contact with the capsule will receive a far greater amount of radiation than tissue at some distance from it. Compare the amount received by a point touching the capsule and by a point, say, 17.5 mm. from it. The first point is 2.5 mm. from the radium and the second is 20 mm. from it: one is eight times as far from the radium as the other. Since all radiant energy decreases with the square of the distance from the source, it is quite obvious that if the tissue adjacent to the radium capsule receives a full dose, tissue only 17.5 mm. from the capsule would receive only one-sixty-fourth of a full dose. It is also obvious that if the radium were kept within the cervix long enough to kill cancer cells at a distance of 17.5 mm. from the cervical canal, the tissue lining of the canal would receive sixty-four times a full dose. This visualizes rather clearly the limited extent of the active radium zone, when radium is placed within the pelvis.

Applying these undeniable facts and laws to radiation treatment of carcinoma of the

cervix, may we not hope to arrive at a basis for the standardization of the treatment of each of the three degrees of the disease as it comes under one's observation, and to fix upon a procedure which is at least theoretically correct, safe, reasonable, and more promising than many of the measures heretofore carried out?

The three degrees of the disease are usually spoken of as "operable," "borderline," and "inoperable" or "advanced." Since none of them is now regarded as operable, we may use the terms "early," "medium," and "advanced."

How, then, shall we treat an early case? In such an instance the disease is supposed to be confined entirely to the cervix. If such be the case, radium alone, placed within the cervix and against it in case of visible ulcer, with a total dosage of about 2,400 mg.-hours, will in almost all cases bring about a prompt and lasting cure.

But who can tell by look or touch whether an early case is really what it looks to be, whether it is really one in which all of the disease is visible or touchable and easily within the zone of radium influence? Who can say positively that cancer cells have not already migrated several centimeters from the initial lesion and are multiplying in tissue well beyond the lethal influence of radium? That many of the apparently early cases have involvement somewhat remote from the cervix has often been demonstrated at operation. It is also very strongly suggested by the fact that many apparently early cases receive a prompt visible and symptomatic cure from one appropriate dose of radium, only to relapse in several months with a rather widespread involvement centering apparently at some distance from the initial lesion. Is not this because there were at the time radium was given some cancer cells already beyond the zone of its curative influence?

With these possibilities in mind would it

not be reasonable and wise to give radium first to every early case, and follow this within ten days (that is, before the radium effect has become too attenuated) by a sufficient amount of X-radiation to bring up the total amount of radiation to *about* an erythema dose to the whole pelvis? In a certain number this would, of course, be unnecessary, for we know that many early cases are cured by radium only, but in others it would prove a life-saving measure.

In cases of a medium degree of involvement, the so-called "borderline cases," the bulk of the disease is still confined to the cervix, but in all probability cancer cells have already migrated some distance—one, two, or three inches from the initial lesion. In these cases the use of both radium and X-rays is certainly most positively indicated. Radium within and against the cervix in safe doses will destroy the bulk of the diseased tissue. X-rays from without will carry the same influence to any cells within the pelvis lying outside of the zone of active radium influence. Either may precede the other, according to the circumstances in each individual case, but not more than a week or ten days should elapse between the ending of one treatment and the beginning of the other. In most cases with this degree of involvement it is wisest to repeat this dosage in about five weeks. The amount of internal radiation at this time, however, should be determined by the presence or absence of the disease locally.

In view of the apparent reasonableness of this method of treatment it is a little difficult to understand why hundreds of cases of this degree of involvement are still treated by radium only. The use of radium alone produces wonderful improvement for the first few months: it destroys the bulk of the diseased tissue, which, being in the cervix, comes within the zone of radium influence. Shortly, however, cancer cells lying beyond the zone of the radium's lethal influence

begin to grow rapidly, and, in spite of the fact that the cervix may have healed, the patient grows steadily worse. More radium proves of little benefit. If an attempt be made to reach the disease by stronger applications of radium, proctitis and cystitis with or without fistulæ result. We have all seen such results and witnessed the distress and suffering of the unfortunate patient. No one who has a thorough knowledge and appreciation of the laws governing the distribution of radiant energy within the pelvis from each of its two sources, could ever think of withholding external radiation and pushing radium to the brink or over the brink of this danger. And yet it is being done, and radium fistulæ are being explained away as a natural result of the disease. The inference is that there are men using radium who do not understand—or, at least, do not hold in mind—the laws governing the distribution of radiant energy.

In discussing the management of advanced cases of carcinoma of the cervix most writers admit that radium is of little value. This is true, but let us look into the matter of why it is true. Because the killing of a comparatively small cylinder of cancer cells in the middle of a large tumor will not materially benefit the patient. In advanced cases the disease has long since spread beyond the radium-active zone. If in a vain attempt to benefit the patient radium should be kept against the remains of the cervix long enough to influence for good cancer cells somewhat remote from the cervix, sloughing and fistulæ will result, with all of their attendant added distress. Radium alone offers little or no hope in such cases.

Obviously the only reasonable method of treating such cases is by external radiation. By using sufficient distance and a sufficient number of points of entry the same influence that radium carries so efficiently to early cases of cancer of the cervix can be

carried to every cancer cell within the pelvis. A week or ten days after this intensive external radiation, its influence should be supplemented by a safe subintensive dose of radium against the remains of the cervix. Treated in this way none of these patients will be made worse, most of them will be very greatly improved, and the few whose neoplasms are highly radiosensitive will receive a complete and lasting cure.

In the April, 1928, number of the *American Journal of Roentgenology and Radium Therapy* there is an article by Dr. Stacy, of the Mayo Clinic, entitled "Complications after Application of Radium to Pelvic Lesions." In this paper Dr. Stacy mentions a number of contra-indications to the use of radium: partially obstructed ureter, edema of the bladder mucosa, and history of previous pelvic infections. She advises that such cases be treated by high voltage X-rays.

I venture to suggest that none of these are contra-indications to the use of radium, but that they are very positive contra-indications to the *over-use* of radium: they are very positive contra-indications for trying to do by radium alone what should be done by radium and X-rays combined.

The horribly distressing sequelæ of radium applications, vesico-vaginal or recto-vaginal fistulæ, trophic ulcers of bladder and rectum, and pyometritis following stenosis of the cervical canal, are none of them sequelæ of a necessary amount of radium therapy, but of an unnecessary and ill-advised amount of radium therapy. They are the sequelæ of trying to do by radium alone what should be done by radium and X-ray combined. They are really the sequelæ of an imperfect appreciation of the fact that X-radiation and gamma radiation act alike on living tissue, but that the distribution of the radiation within the tissue, from these two sources, is vastly different.

SUMMARY

1. A review of the literature reveals a regrettable diversity of opinion on the radiological management of this disease.

2. I believe it can be theoretically demonstrated and upheld by recorded results that the gamma rays of radium and X-rays are equally important in the radiotherapeutic management of carcinoma of the cervix, and I think that no one is justified in using one to the exclusion of the other.

3. In early cases, radium is of chief importance, but all of these cases would be safer if external radiation were added shortly after the radium treatment.

4. In borderline cases, radium and X-

ray are of equal importance. Either may precede, but the other should follow within a week or ten days as a supplement.

5. In advanced cases, the X-ray is of far greater importance than radium and should always be given first. Its action, however, should be supplemented by guarded doses of radium from within.

6. There are no contra-indications to guarded doses of radium used as supplements to external radiation.

7. Individual variations in technic are to be expected, but we should be able to agree upon the principles underlying the management of each of the three degrees of this disease.

Brain Abscess in Frontal Lobe Resulting from Acute Frontal Sinusitis and Osteomyelitis of Orbital Plate. F. H. Brandt. The Laryngoscope, November, 1928, XXXVIII, 712.

The author reports a case of brain abscess involving the right frontal lobe, following a severe right frontal sinus infection which was followed, in turn, by an osteomyelitis involving the posterior wall of the sinus. The brain abscess was drained and this was followed by two distinct attacks of meningitis, with an apparent recovery.

The author follows this case report with a review of a large number of cases of brain abscess sequela to accessory nasal sinus infections, and comes to the following conclusions:

"1. Most cases found seem to favor the young, the diploe being more spacious and the mucosa being in more intimate relation with the bone tissue, and the lymphatic and

vascular system being more profuse, might account in a way for the occurrence in early life.

"2. Headache which is persistent after thorough drainage for a frontal sinus operation should always be watched very closely.

"3. The occurrence of paresthesia of the opposite arm almost always means a frontal lobe involvement.

"4. Eyeground changes should be watched very closely; when present is a sure index of increased brain pressure, and a timely eradication of this pressure will obviate changes in the optic nerve.

"5. Drainage in brain abscess should rather be prolonged than shortened.

"6. Osteomyelitis of the cranial bone has a tendency to be progressive, which in our case accounted for two distinct attacks of meningitis."

B. C. CUSHWAY, M.D.

REGAUD'S TECHNIC IN CERVICAL CANCER: USE OF NEW RADIUM APPLICATOR¹

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THE purpose of this paper is twofold: first, a plea for American radiologists to give more consideration to the adaptation of the Regaud technic in treating cervical cancer, and, second, to describe a new radium applicator that aids in the simplification of this technic.

SUPERIORITY OF RADIATION METHODS

The superiority of radiation therapy over surgery in the treatment of carcinoma of the cervix is now generally recognized by surgeons and gynecologists all over the world. In a number of the leading surgical clinics of this country the radical operation for cervical cancer has not been used for more than five years. It is not within the scope of this presentation to attempt to prove the claims for the superiority of radiation therapy in the treatment of this condition. Those who may question this statement are referred to the numerous references in the literature, largely contributed by leading American gynecologic surgeons such as Howard Kelly, of Johns Hopkins; John A. Polak, of Long Island College Hospital; Henry Schmitz, of Loyola University, Chicago; John G. Clark and Charles C. Norris, of the University of Pennsylvania; William P. Healy, of the Memorial Hospital, New York; Frank W. Lynch, of the University of California, and scores of others.

AMERICAN METHODS OF RADIUM THERAPY

Numerous methods for applying radium in cervical cancer have been advocated by various American workers, space permitting not even an enumeration of these different

technics. In general, the tendency has been to use medium to large amounts of radium (100 to 1,000 milligrams), moderately filtered (0.5 mm. silver plus 1.0 mm. brass or more lightly filtered needles), with but few individual radio-active centers, and to give the entire treatment within a comparatively short period of time, immediately after the diagnosis has been established, with little or no preliminary treatment.

A technic that has been popular in America is one advocated by the late John G. Clark, Professor of Gynecology at the University of Pennsylvania. Clark used a short "T"-shaped applicator which provided filtration with 1 mm. brass (density 8.5) and 0.5 mm. of aluminum. With this device radium is introduced into the cervical canal and placed against the vaginal portion of the cervix, providing two radio-active centers, each of which usually contains 50 mg. of radium. The length of each portion is about 3 cm. and the duration of the treatment, as originally recommended by Clark, is approximately 24 hours (2,400 milligram-hours), although some radiologists give from 3,000 to 3,600 milligram-hours.

REGAUD TECHNIC

The splendid results which Regaud, of Paris, has achieved in the treatment of cervical cancer have attracted the attention of radiologists everywhere. Claude Regaud is the Director of the Radium Institute of the University of Paris and is the associate of Madame Curie. His reputation among radiologists is universally acknowledged and there is perhaps no one who enjoys greater prestige as a radiation therapist. The Radium Institute of Paris is one of Europe's

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leading cancer clinics, and, as its Medical Director, Regaud has had exceptional opportunity for clinical study. In addition, there has been available for his use one of the largest supplies of radium in the world—9,500 milligrams.

(A) PRINCIPLES OF REGAUD TECHNIC

The cardinal principles as advocated by Regaud in the treatment of cervical cancer are:

1. Proper preliminary treatment.
2. Rigorous asepsis.
3. Use of a comparatively small amount of radium, over a long period of time, giving the greatest possible dosage without injury to surrounding normal tissues.
4. Employment of a number of radioactive centers distributed throughout the entire uterine canal and in the vagina.
5. Use of heavy filtration (by dense metals such as gold or platinum), which emits only the deeply penetrating gamma rays of radium, thereby avoiding necrosis of the tissues.
6. Use of external radiation in addition to the intra-utero-vaginal radium therapy, when the parametrium is involved.

Regaud performs a biopsy upon every tumor as soon as the patient presents herself at the clinic, inasmuch as all treatment is based upon the microscopic diagnosis. Biopsy carries insignificant hazards in cervical cancer because the lymph and blood channels are already blocked by the ulceration that is invariably present. At this time a culture is also made of the cervical and vaginal flora. Local infection constantly accompanies cervical cancer at the moment it opens into the vagina. At first superficial, it later extends deeply, equalling the progress of the cancer. Radium is not applied until the vaginal infection is markedly reduced.

(B) PRELIMINARY TREATMENT

I am indebted to George T. Pack, of the Memorial Hospital, New York, for the fol-

lowing brief description of Regaud's technic:

"A douche of the vagina twice daily with an antiseptic solution is prescribed until the day of treatment. The putrefactive microbes disappear readily under this local treatment, but the pyogens, namely, the staphylococcus and streptococcus, are more difficult to destroy. Autogenous vaccines are responded to by the staphylococci, but the streptococci, particularly those of the dangerous hemolytic type, are very resistant. In every instance where internal radium therapy has been followed by severe pelvic infection, the preceding bacteriologic analysis has demonstrated the presence of hemolytic streptococci; on the contrary, not every patient harboring these streptococci within her vagina will suffer this complication.

"The ablation or curettage of cancerous vegetations of the uterine cervix has certain advantages: it facilitates treatment; it may suppress the suppuration from the infected cervix; it frees the implantation of the cervical tumor from the orifice of the uterine canal; it permits closer approximation of the radium foci to the outlying cancer tissue; it favors cicatrization and lessens the danger of toxemia from absorption. A bleeding, infected, sphacelic, 'cauliflower' cervical tumor should be amputated, preferably by diathermo-coagulation, previous to the introduction of the radium into the vagina and uterine canal."

(C) TECHNIC OF RADIUM APPLICATION

"The intra-uterine applicator is a blind rubber tube, 2 mm. thick, 6 cm. long and having a bore of 3 mm. Each radium-bearing capsule which it contains is 20 to 22 mm. long; each has a radiating surface of 0.6 by 15 mm. and a wall thickness of 1 mm. of platinum. Each capsule is individually wrapped in 0.2 mm. of aluminum foil to arrest the secondary radiation from the primary platinum filter. In summarizing, then, the rubber tube has a radiating surface

of 6 to 7 cm., a focal distance of over 3 mm. and a filtration of 1 mm. of platinum for the rays.

"The accompanying vaginal applicator is known as the Curie colpostat. Each cork is 1.5 cm. broad and 2.5 cm. long, so that with the radium-containing capsule within its interior, more than 0.5 cm. wall of cork is left on either side. Each capsule within the center of the cork has a wall of 1.5 mm. of platinum, primary filter, and a secondary filter of 0.2 mm. of aluminum. Two of these corks are mounted on a 1×10 cm. steel strip covered by rubber tubing. The ends of the cork are sealed with plugs. Then the entire apparatus is immersed in boiling paraffin at 120 degrees C. for twenty minutes, for the purpose of sterilizing and rendering the colpostat impermeable to the vaginal fluids. It should be noted that only the ends of the capsules are directed toward the rectum and bladder.

"The depth of the uterine cavity is measured by a sound in order to plan the size of rubber tube to be introduced the following day. It is essential for the entire length of the uterine cavity to be filled with radium-bearing tubes. A week or ten days having passed since the biopsy and bacterial culture, the patient is admitted to the hospital, where on the first morning the uterus is sounded and the cervical canal dilated without an anesthetic, by the use of graduated French uterine sounds, until the maximum is reached. The patient is then returned to bed and her temperature is taken at frequent intervals during the remainder of the day and night. If there has been no increase in temperature, then on the following morning the internal radiation is begun. The applicators are introduced into the uterus and vagina without the use of an anesthetic. The treatment continues for five days, in order to obtain the required dosage. Every morning during these five days, all the radium is removed from the uterus and

vagina; the patient is given a douche; the rubber tube and contents are boiled; the corks are cleaned with antiseptic solution and the entire apparatus lubricated and re-introduced.

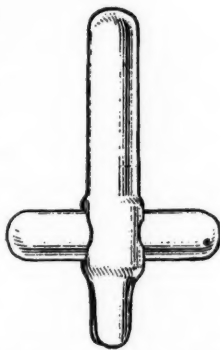


Fig. 1. The Clark cervical applicator, actual size. (Designed by the late John G. Clark, Professor of Gynecology, University of Pennsylvania.) A popular radium applicator for cross-firing on the cervix, especially in cervical cancer. As a rule 50 milligrams of radium are placed in the cervical arm and a similar amount in the arm across the cervix.

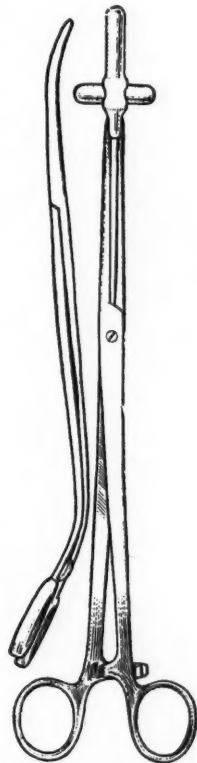


Fig. 2. Illustrating the method by which the Clark cervical applicator can be inserted by means of a curved uterine dressing forceps or a specially designed forceps.

"The extreme frequency of parametrial infiltrations and the impossibility of making a diagnostic differentiation between inflammatory and neoplastic indurations necessitate the employment of irradiation to all the pelvic territory invaded or menaced. In lieu of concentrating the radio-active substance in a single foyer or focus occupying a space confined to the center of the neo-

plastic zone, the total quantity is divided into multiple tubes or capsules (5 to 8 in uterus and vagina). The uterine canal contains three or sometimes four platinum capsules of radium element. In the concavity of the colpostat, intermediate loaded corks are placed if necessary. If the uterine canal

um therapy by roentgen therapy or by transpelvic curietherapy."

AMOUNT OF RADIUM USED AND NUMBER OF RADIUM CENTERS

With the technic described above, Regaud uses six radio-active centers in the average

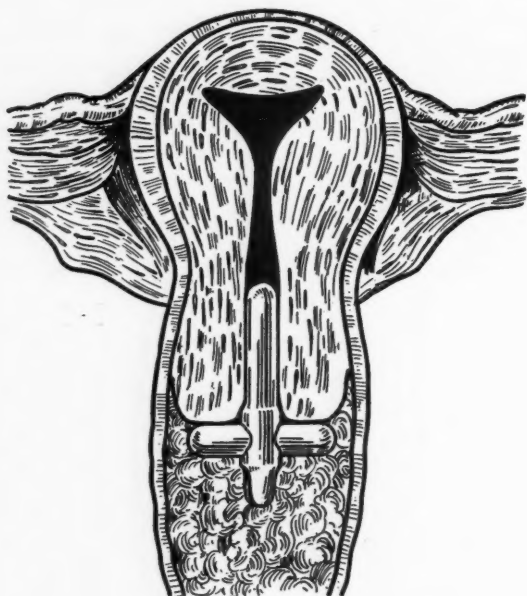


Fig. 3. How the Clark cervical applicator appears when it is in position in the cervical canal. Its purpose is to irradiate the cervix from two radio-active sources with moderately filtered gamma rays of radium. It is held in position by voluminous gauze vaginal packing.

is impermeable, the treatment is made at two successive times, the vaginal applicator first (colpostat), the uterine applicator later, after regression of the neoplasm has disengaged the canal. If sclerosis of the vagina and atresia of the uterine canal will not permit the employment of this typical disposition, even when two successive treatments are used, then curing by utero-vaginal application of radium is improbable. In such a case one must be content with palliation or else augment the internal radi-

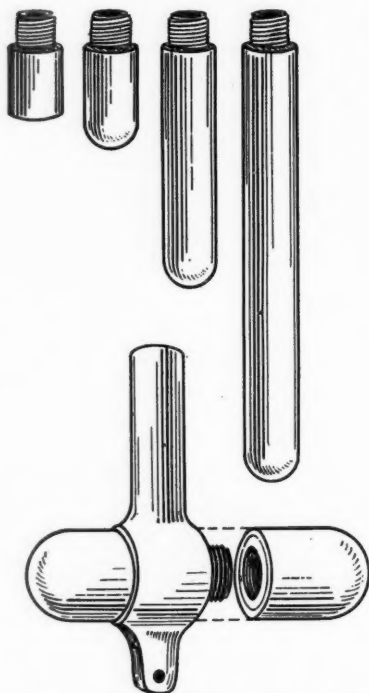


Fig. 4. The individual parts of the author's uterine radium applicator, actual size. It is designed to irradiate the entire uterus, especially in cervical cancer. The uterine portion consists of graduated parts to accommodate the varied uterine measurements (from 4.5 to 10.5 cm.). Before using the applicator, the length of the uterine canal is determined by a sound. This permits the assembling of the applicator to conform to each individual case.

patient, three intra-uterine and three intra-vaginal. Radium in element form is placed in each center containing 6.66 or 13.33 milligrams. In the majority of patients 33.32 milligrams is placed in the uterus and a similar amount in the vagina, or a total of 66.64 milligrams.

SIMPLIFICATION OF TECHNIC BY USE OF NEW
RADIUM APPLICATOR

As mentioned above, three separate applicators are used in an average case of cervical cancer—one that occupies the entire uterine canal, one that fits against the cer-

The walls of the uterine portion are 1.75 mm. of gold covered with 0.5 mm. of aluminum, and the vaginal portion 3.5 mm. of gold covered with 1.0 mm. of aluminum. The bore of the uterine portion is 3.5 mm., the vaginal portion 4.5 mm. The uterine portion consists of a number of graduated

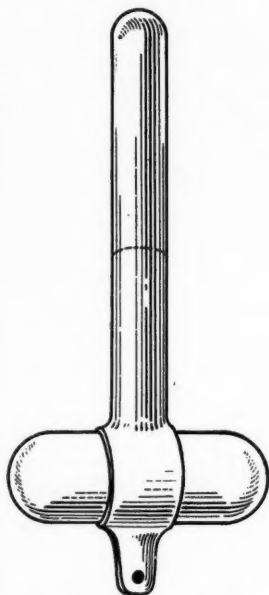


Fig. 5. The author's radium applicator assembled for use in a uterus of average length, actual size. As a rule, three sources of radium are placed in the uterine arm and one in the arm across the cervix.

vix, and another, the "colpostat," that is placed in the lateral vaginal fornices. The author has attempted to simplify this technic by combining the two first mentioned applicators, thereby using two instead of three. This has been accomplished by a modification of the John G. Clark cervical applicator previously described.

The applicator lately devised consists of 22 carat gold of special alloy throughout. Gold is used instead of platinum because it is much less expensive, yet is nearly as dense as platinum. Pure gold (24 carats) has a density of 19.3; platinum, 21.5.

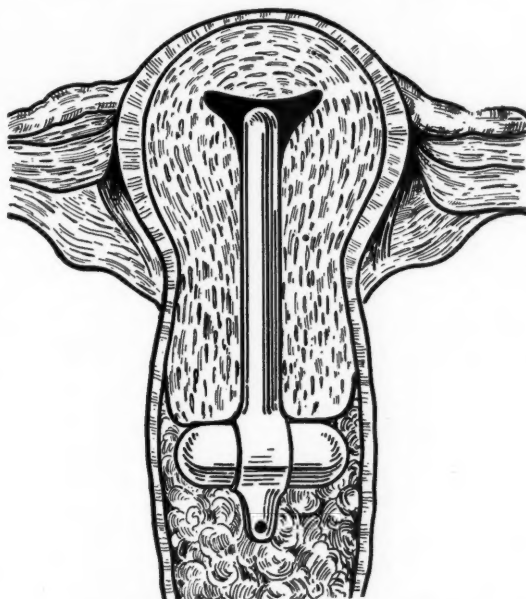


Fig. 6. How the author's radium applicator appears when it is in position in the uterus. Its purpose is to radiate the entire uterine canal and to cross-fire on the cervix with heavily filtered gamma rays of radium, usually from four radio-active sources. The filtration in the vaginal portion is twice as great as in the uterine part, thus affording protection to the vaginal mucosa. The applicator is held in position by voluminous gauze vaginal packing.

sections, so that an applicator can be assembled for various uterine canal measurements of from 4 to 10 centimeters in length. The gold used has an approximate density of 18.4, providing thickness to the uterine portion, which gives a filtration equivalent to 1.5 mm. of pure platinum, while in the vaginal portion double this filtration is accomplished. (The filtration in the uterine portion is approximately four times as great as in the Clark cervical applicator, due to its greater thickness and to the fact that gold is

so much more dense than brass.) The outside diameter of the uterine portion is 8 mm., which can be readily covered with one or more thicknesses of para rubber, a rubber which contains no metallic element and therefore eliminates any caustic effect due

constructed to conform to each individual case (insuring success of the Regaud technic), the length of the uterine canal should first be determined by means of a sound. The applicator can be readily introduced by a uterine dressing forceps or special forceps,

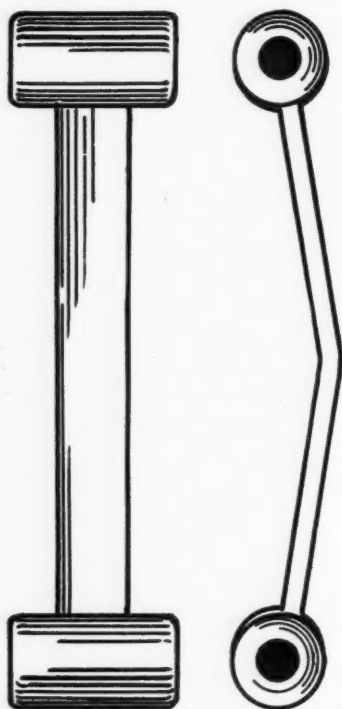


Fig. 7. Left, end view; right, side view of the Kaplan colpostat, three-fourths actual size. (Designed as a modification of the Curie colpostat, by Ira I. Kaplan, of Bellevue Hospital, New York.) It consists of two rubber barrels containing heavily filtered capsules of radium held together by a clock spring covered with rubber. It is the principal vaginal applicator for radiating the cervix and parametria in cervical cancer, and may be used in conjunction with the author's applicator for carrying out the Regaud technic.

to secondary radiation. In the average size uterus, three radium needles or tubes can easily be placed in tandem in the uterine portion and one or more needles or tubes in the vaginal portion.

That the applicator may be properly con-

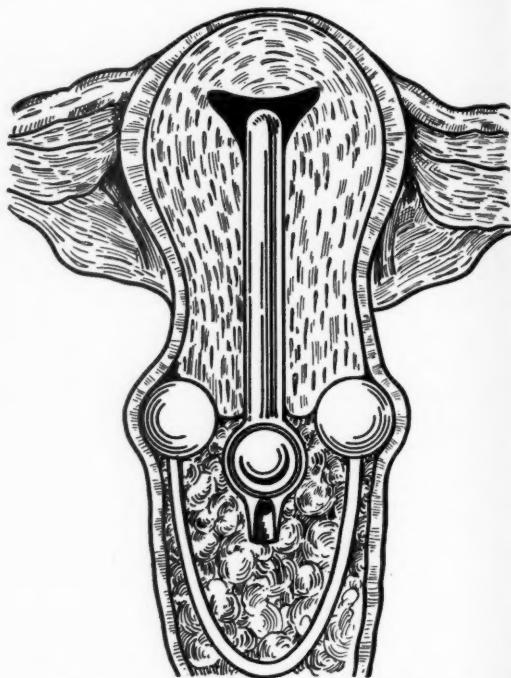


Fig. 8. This illustrates how the author's radium applicator and the Kaplan colpostat appear when placed in position for treating cervical cancer. By this means six radio-active centers are provided in the average case—three in the uterine canal and three in the vagina, thus carrying out the principle of the Regaud technic.

for a slot in the vaginal portion of the applicator is provided for this purpose.

The ideal manner for using this applicator, in treating cervical cancer, is in conjunction with the colpostat devised by Kaplan. With this method, six radio-active centers are supplied, all heavily filtered, and the technic, so successfully carried out by Regaud, is readily administered.

RADIUM DOSAGE

The usual radium dosage that Regaud uses is 6,660 milligram-hours, although as

high as 8,000 milligram-hours may be given without inconvenience if six radio-active centers are used. When the incomplete permeability of the uterine canal, the smallness, or insufficient suppleness of the vagina, does not permit the insertion of more than three or four radio-active centers, the radium dosage is diminished to 4,000 to 5,300 milligram-hours. It is dangerous to exceed 8,000 milligram-hours because it may expose the patient to vaginal, rectal, and vesical lesions, with no additional therapeutic compensation. The large radium dosage employed is possible because of the multiple radio-active centers and the heavy filtration used.

One of the interesting features of the Regaud technic is that this large radium dosage is accomplished by the use of a comparatively small amount of radium. As previously mentioned, Regaud has at his command one of the largest supplies of radium in the world, yet, in the average cervical cancer, he uses but 66.6 milligrams of radium element for the utero-vaginal treatment. The reasons for applying this small amount of radium for a long period of time (approximately 100 hours in the average case), follow.

RATIONALE OF LARGE RADIUM DOSAGE SLOWLY ADMINISTERED

It has been definitely established that in the course of their existence cancer cells pass through alternating phases of radiosensitivity and radioresistance. The cells are particularly radioresistant when for a long time they have been in a state of rest. They are most sensitive to the action of radium when they are in the state of mitosis, or indirect cell division. The use of a large amount of radium for a short period of time will destroy only those cells which at the moment are in a state of maximal radiosensitivity, and spare the others. On the contrary, a long irradiation, or a treatment

by repeated doses over a certain period of time, destroys all the mother cells successively, because, as the cycle of cellular renovation continues, each cell passes at some time into the phase of maximal sensibility and at the same time the patient is saved a

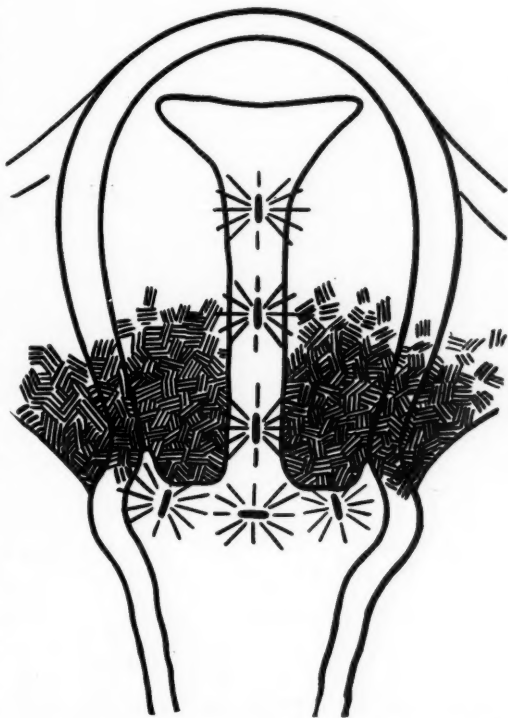


Fig. 9. A schematic drawing showing an early Stage 3 cervical cancer, the type most commonly present when the patient presents herself for treatment. The position of the radio-active centers, in accordance with the Regaud technic, is shown in the uterine canal and vagina, thus radiating the entire uterus, cross-firing on the cervix, and sending radiation into the parametria.

severe reaction, which is common when the time of irradiation is short and the amount large.

By the use of heavy filtration the caustic effect of any beta-ray radiation, with its attending necrosis, is eliminated. The treatment interval is necessarily prolonged, which, as previously mentioned, increases the chances of destroying additional carcinomatous cells.

SUPPLEMENTARY TREATMENT

In the event of an extensive cancerous infiltration (parametrial invasion) it is not possible to cure the patient by intra-uterovaginal radium therapy alone. These cases necessitate additional radiation from without. If high voltage X-ray therapy is to be used it should preferably be administered first, then followed immediately by the internal radium therapy. Regaud contends that X-rays are especially inefficient after radium therapy has been given by the uterovaginal method, although many radiologists do not agree with this contention. On the other hand, if external radium therapy is to be used (with the so-called "radium pack"), treatment is begun immediately after the radium has been removed from the uterus and vagina.

Regaud does not recommend post-radiation hysterectomy except in those who were apparently operable before the radium treatment. The results from irradiation alone in such patients are so good that the operative risk will more than equal the small percentage of supplementary chances of curing which hysterectomy gives.

The so-called first degree growths, those strictly limited to the cervix, are the only good operable cases. In such instances treatment can be either by hysterectomy, radium, or radium followed by hysterectomy. Unfortunately cases in this class are infrequently seen, constituting only about 10 per cent of all patients who present themselves to Regaud's clinic. Surgery must also be given consideration in the infrequent cases of adenocarcinoma of the cervix (which are usually resistant to radium), cancers coincident with an adnexal infection, cancers persisting after the failure of preceding radium treatment, and cancers coincident with vaginal deformities of certain types.

RESULTS

The statistics from Regaud's clinics have been among the most encouraging from any

large institute, considering the percentage of advanced lesions treated. Ninety per cent of their patients have doubtful operable or inoperable lesions when first seen (10 per cent operable or Stage 1, 33 per cent doubtfully operable or Stage 2, 57 per cent inoperable or Stages 3 and 4). Regaud's percentage of cures has shown a yearly increase since the radiation method was adopted in 1919, but unfortunately no published statistics are available since 1926. After more than five years' use of the method described above, treating *all* stages of disease, 43.9 per cent of their patients were free from clinical evidence of the condition one year after treatment was begun, with a 26.2 per cent five-year salvage. The results of the treatment naturally depend upon the stage of the disease when treatment is begun, *i.e.*, of the so-called operable and doubtful group (Stages 1 and 2) treated by radiation alone, 70.8 per cent are free from disease one to two years after the treatment, with a mean average of 42.4 per cent for all such cases covering a period of from one to seven years.

CONCLUSIONS

The Regaud technic of treating cervical cancer is an efficient, slow, intensive method of radiation therapy, which apparently has a number of advantages over the radiation methods that have generally been used in this country. These are:

1. The preliminary treatment controls to a large extent the accompanying local infection, thus increasing the patient's general resistance.
2. The careful aseptic technic of radium application with change of applicators during the treatment prevents severe infection following the treatment.
3. The small amount of radium used prolongs the radium treatment, thus increasing the possibility of administering the radium when the cancerous cells are in a state of maximal radiosensitivity.

4. The employment of multiple centers of radio-activity with wide distribution offers a more uniform radiation, and permits a large radium dosage to be administered, not only to the visible growth but also to the zone of potential malignancy which surrounds it.

5. The use of heavy filtration protects the normal tissues and avoids severe local reactions with their attending necrosis, and prolongs the treatment, thereby increasing the chance of destroying additional carcinomatous cells.

The use of a new radium applicator aids in the further simplification of the technic by—

(1) Providing a single instrument for irradiating the entire uterine canal as well as the vaginal portion of the cervix, thus reducing the number of applicators to two.

(2) Being readily adjustable, uterine canals of various lengths may be adequately irradiated.

(3) Offering a heavier filtration, which permits only the penetrating radiation from the hard gamma rays of the smallest wave length, thus avoiding any caustic radiation, with its attending necrosis and subsequent sloughing. (Filtration is approximately 50 per cent greater than that used by Regaud.)

(4) Providing filtration twice as great in the vagina as in the uterine canal, thus protecting the sensitive vaginal mucosa and thereby greatly reducing the possibility of fistula formation.

(5) Can be procured at a much lower cost than an applicator of platinum filtration.

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DISCUSSION

DR. HENRY SCHMITZ (Chicago): The symposium this morning on the treatment of carcinomata of the cervix has given us a vast amount of information: it is really impossible in the short time allowed for discussion to touch on all the phases that were presented. If you should ask me what I consider the important things in the treatment of carcinomata, I would answer early diagnosis and co-ordinated clinical organization. Dr. Sittenfield this morning mentioned that the group of medical attendants should consist of a surgeon, an internist, a gynecologist, and a radiologist. I feel that we should have men specially trained in the treatment of carcinoma of the various organs or specialties.

Coming to the individual papers presented this morning, one feels that a paper on the standardization of radiation therapy of cervical carcinomata is very timely. It is fair to say that we are gradually approaching a standard in X-ray and radium treatment of carcinoma of the cervix, as Dr. Lawrence found in his paper. However, physicians are individualists and patients should be treated as individuals and there will always be differences in the technic of the treatment used by the various men.

The radium applicator demonstrated by Dr. Swanberg is undoubtedly an advance in radiation therapy. It permits a great leeway in the modification of treatment. The heavy

gold filtration shuts out the rays of longer wave lengths and necrosis should therefore be avoided. I wish to ask Dr. Swanberg to give us the time period within which the 6,600 milligram-element hours of radium are applied. This, in my opinion, is very important.

Dr. Stevens has given us a masterly presentation of the subject. However, I wish to add that a uterine examination of the urinary bladder should always be made before beginning the treatment. It is impossible by a vaginal examination to determine whether there is or is not an invasion of the bladder and rectum. We should abstain from radium therapy if the bladder is involved, until the bladder mucosa has shown a tendency to heal after a series of X-ray treatments. This precaution will reduce the number of fistulae of the urinary tract following radiation therapy.

Dr. Dorland's paper is a distinct contribution to the subject of ovarian tumors. Radiation therapy after operation for papillary cystadenomata of the ovaries very often will prevent recurrences or metastases from the spilling of the epithelial cell elements on the peritoneum. In 1922 I published a series of cases of ovarian tumors which had been treated with surgery and radiations and showed the symptomatic relief that can be obtained with therapy. I have frequently seen patients in apparently perfect health for three or four years after radiation therapy for incompletely removed carcinoma of the ovaries. In this series was one patient who has now remained well for more than eight years. It happens to be a case of sarcoma.

DR. SIDNEY BARROW (Shreveport, La.): I wish to confine my remarks to the papers of Dr. Lawrence and Dr. Stevens. Relative to the Regaud technic, I have had no experience. It has always appeared to me as illogical to go out hunting big game with small ammunition, but I would not presume

to question such a distinguished gentleman's technic, or his results. About five years ago I presented a paper before this Society along the lines of Dr. Lawrence's paper, and I stressed the point, or attempted to do so, of the necessity of a combination of radium and X-radiation in the treatment of pelvic carcinoma. I attempted to bring out the point there that it was physically impossible to distribute the dosage as it is desirable to do, by simply trying to follow the various twists and curves that have been handed out to us to follow. We must hold in mind the physical laws as stressed by Dr. Lawrence, and have in mind the *time* of each radiation. In our work, and I am on the firing line, I feel the responsibility to the patient—I feel that I must not consider my patient as a mere phantom of wax or water. The result is what I am held accountable for, and the result—or, rather, the technic followed—is so similar to that of Dr. Lawrence that I feel grateful to him for having brought it before you again. One point of difference, however: I feel that it is absolutely necessary to give the maximum dose of X-radiation preceding the radium radiation intended. In my work I make no attempt at classification; I do not believe it does any good. Once I determine my patient has a cancer of the cervix or the uterus, I feel that the very maximum radiation that the normal tissues will stand should be given, regardless of whether it is an early, in our minds, or advanced case. I precede all cases of carcinoma of the cervix with an intensive X-radiation which approximates, if I may use the term "erythema," 130 per cent to the depth. Within two weeks, fourteen days, I then administer our radium radiation, which is at a period of time when the X-radiation is beginning to subside. By the time the radium reaction attains its height I have continued through a period of four or more weeks, almost a continuous radiation, not true saturation, but almost continuous radiation effect. I have treated, since 1918, 541 cases, and

while I am not in position to tell you accurately the results, in our locality we get somewhat of an intimate contact over years with these persons, and I feel satisfied that we are doing good. I wish to congratulate Dr. Lawrence and Dr. Stevens particularly on bringing the subject again before you.

DR. LAWRENCE (closing): Two things prompted me to select this subject for discussion: First, the fact that a large percentage of these cases sent in to me from the surrounding territory have already had ill-advised doses of radium—some have had too little, many have had too much. Men of inadequate radiologic training who purchase radium have little conception of the relation that should exist between radium and X-rays as applied to carcinoma of the cervix.

Secondly, there applied to me for advice a young man of excellent college training who had recently decided to enter the field of radiology. He was much interested in the whole subject of cancer, and quite familiar with the literature on the treatment of carcinoma of the cervix. He stated that the more he read the less able he was to arrive at a definite conclusion as to the right method of using radium and X-rays in combating this disease.

It occurred to me that after more than twenty years' experience with radium, and nearly ten years' experience in the use of X-rays of sufficient penetration, radiology should be able to arrive at a standardized method of procedure—a method based not only upon a digest of the experience of many workers, but also upon a full appreciation of the physical laws governing the distribution of radiant energy from each of the two sources used. This would mean the standardization of radium and X-ray treatment of this disease.

In less than ten years surgery standardized many of its major operations. Here is the most important major operation of

radiology, and, so far, there has been no concerted effort to arrive at the best method of performing it.

I believe that this is a matter of such prime importance that a committee should be appointed from this Society to formulate a standard method of procedure to be carried out for each of the three degrees of the disease as it presents for treatment. It is not unlikely that this would raise the percentage of salvage in these cases from the present 20 per cent to approximately 90 per cent. Then would these patients receive not a part, but all, of the benefit that radiation has to offer.

DR. SWANBERG (closing): In reference to the uterine applicator demonstrated, I might mention that the bore of the uterine portion is 3.5 mm., the vaginal 4.5 mm. If you have five, ten, or twelve and one-half milligram needles of radium, they can readily be placed side by side or in tandem in the applicator. In our work we place four 12.5 milligram needles in the applicator, together with two of the same type in the colpostat, or 75 milligrams in all for the average case. With this amount we give from 75 to 100 hours treatment or a maximum of 7,500 milligram-hours, if six radium centers are used. We usually figure on using 1,100 to 1,300 milligram-hours per radium center. If the uterus is small, we use only 62.5 milligrams in all; if large, 87.5 milligrams.

We have not followed Regaud's plan of changing the applicators every day because of the inconvenience to the patient. We find one change during the treatment—at the end of forty-eight hours—is practical and sufficient. The danger of leaving the applicators in position too long must be considered, however. If the temperature exceeds 102 degrees we withdraw the applicators, administer a thorough cleansing douche, and do not replace them until the temperature falls. If the patient has been properly prepared for radium treatment, by repeated

douches over a number of days, the likelihood of the temperature becoming unduly elevated is not great.

The special advantage which our applicator affords is its great density. This can best be appreciated by comparing it with the Clark applicator—its density is 8.5 throughout, because of the filtration by 1 mm. of brass. In our applicator the density in the uterine portion is 32.4 and in the vaginal portion 64.8, which is four and eight times, respectively, that afforded by the Clark applicator, emitting only the very short, non-caustic gamma rays.

Referring to the idea of "shooting big game with a small gun," the proof of the effectiveness of Regaud's technic is in the results secured. Regaud's statistics are the best that have ever been published from a large clinic. As far as we are aware, no one, as yet, has shown better than a 27 per cent five-year salvage in cervical cancer, when 90 per cent of the patients were inoperable when first seen. These results alone are sufficient to commend the technic, and, until they are surpassed, it is the duty of the conscientious radiologist to at least give the method serious consideration.

DR. STEVENS (closing): I think that this is probably the first time in the history of radiotherapeutics that three papers have been presented by three men from different sections of the United States, each working independently of the other, in which the principles for efficient irradiation of carcinoma of the uterine cervix stressed by each author are in such close agreement. The principles involved in the treatment of this disease, at least, appear to be well standardized. I agree absolutely with what Dr. Barrow has said about applying the maximum treatment to the cases, even in the earliest stages. These are the cases that are going to give us our ultimate cures. One should not withhold the radical methods of treatment simply because the patient does

not appear to be very ill and because the disease seems to be in a very early stage. We all know the ultimate outcome of such cases when the disease is not absolutely wiped out.

Someone raised the question of using large *vs.* small quantities of radium, *i.e.*, comparatively small quantities. The use of small quantities of radium for long periods of time has the advantage that the healthy, normal tissues are affected less, whereas the destructive action on the diseased tissues is greater. This latter reaction is, of course, very important, and is due to the fact that the longer the application of radio-active substances the greater the number of cancer cells affected by the radiations during mitosis. When a cancer cell is undergoing mitosis its resistance to irradiation is much less than that of the resting cell. When using large quantities of radium for shorter periods all of the above conditions are reversed.

The continuous effect I have sought to establish and maintain in all of the cases treated. That is the idea in mind when the treatment is begun with the roentgen rays, then radium, and finally roentgen rays again. By this method, just when the superficial structures are beginning to show signs of roentgen irradiation this method of treatment is stopped and the radiation is kept up by the use of radium applied within the cervical and uterine canal. When the skin reaction disappears and the radium treatment is completed it is then advisable and perfectly safe to give further roentgen irradiation through the ports used during the preliminary roentgen irradiation.

DR. DORLAND (closing): I have nothing to add to my paper, except to say that my one object in presenting it was to add the opinions of you skilled roentgenologists to the few published opinions of the surgeons on the value of deep radiation therapy in pelvic and abdominal malignancy.

EDITORIAL

M. J. HUBENY, M.D. Editor
BENJAMIN H. ORNDOFF, M.D. } Associate Editors
JOHN D. CAMP, M.D. }

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CARCINOMA OF THE CERVIX

Radiology occupies a somewhat unique position in regard to the treatment of carcinoma of the cervix uteri. Formerly surgery was the only recognized method of attack: to-day, so superior are the results obtained by radiation that surgeons everywhere are gracefully yielding this field to radiology.

Surgery has never been a successful method of treatment except in the very early stages of the disease. Now because of the position of the tissue involved, and because of the fact that the early symptoms are hardly more than those to which many women are at times accustomed, this disease will never lend itself to early diagnosis. On this account the number of cases at all suitable for surgery has always been quite small as compared with the great number which has been seen too late for surgery. The field of surgery in this disease has always been a narrow one.

The field of radiology is broad, offering at least something in practically all stages of the disease. Some of the most advanced cases will receive the greatest palliation; a few quite advanced cases will receive a lasting cure; borderline cases are almost as suitable for treatment as early cases; very early cases show a high percentage of lasting cures.

But if the position of radiology in the treatment of cancer of the cervix is some-

what unique for what it has accomplished, it is even more so for what it has not accomplished. We have in radiant energy an agent capable of doing far more than is being accomplished by its use to-day. Radiologists in general are not thoroughly awake to the strength of their own weapons, nor sufficiently familiar with certain basic principles underlying their use.

We have two sources of radiant energy of such wave length as has destructive influence on cancer cells—radium and the high voltage X-ray tube. There is no point in general medicine upon which more confusion has existed than upon the relation holding between X-rays and radium rays, and some of this lack of clearness of thinking has extended into the field of radiology. After ten years of high voltage X-rays and more than twenty years of radium there is little or no unanimity of opinion as to the place of each of these two sources of radiant energy in the treatment of this disease. What agreement there is, is based more upon empiricism—that is, individual experience—than upon scientific principles.

Some men are pointing with pride to 25 per cent five-year cures of all early cases and are quite satisfied with 8 per cent five-year cures of all cases treated; others can show 60 per cent of all early cases well from 2 to 9 years and 30 per cent of all cases well from 1 to 9 years. There is no excuse for this wide variation in the number of cures by different men. All have radium, all have high voltage X-rays, but all have not learned the relative value of each or the joint value of both.

And here is the thing that radiology has not accomplished. The most dreaded disease of women has been given into our hands for treatment. We have been made

solely responsible for its management and cure, and yet to date there has been no united effort made to determine upon the best possible method of administering radiation. Thousands of women are dying because X-rays and radium, as they are being used to-day, are curing only about half the number of cases that they are capable of curing when used by the best possible method. X-rays and radium applied in a most haphazard manner will cure some of these cases, and with that small number we have all too long been too nearly satisfied.

There is a crying need for counsel among radiologists—counsel which may determine upon a general plan of attack upon each of the three degrees of the disease as it presents for treatment. There is a crying need for standardization of X-ray and radium treatment of carcinoma of the cervix. Only then will all the lives be saved that radiation is capable of saving.

W. S. LAWRENCE, M.D.

AMERICAN RADIUM SOCIETY

The American Radium Society will hold its fourteenth annual meeting in Portland, Oregon, at the Heathman Hotel, Monday and Tuesday, July 8 and 9, 1929. The Program and Local Arrangements Committees have arranged a most interesting scientific program. The following is a tentative arrangement:

July 8, 1929, morning session.

1. DR. E. C. ERNST. President's Address.
2. DR. EDITH H. QUIMBY. "A Comparison of Radium and Radon Needles and Permanent Radon Implants."
3. DR. R. L. SANTE. "Cell Nutrition—One of the Largest Factors Governing Radiosensitivity."

4. DR. HAYES E. MARTIN and DR. EDITH H. QUIMBY. "Calculations of Tissue Dosage in Radiation Therapy: A Preliminary Report."
5. DR. ROLLIN H. STEVENS. "Comments on Radium Technic."
Discussion: DR. G. E. PFAHLER,
DR. G. W. GRIER,
DR. JOHN R. RANSON.
6. DR. D. T. QUIGLEY. "How shall Modern Science Orient Cancer?"
Discussion: DR. O. L. NORSWORTHY,
DR. L. T. LEWALD.

July 8, 1929, afternoon session.

7. DR. JOSEPH C. BLOODGOOD. Title to be Announced.
8. DR. FRANCIS CARTER WOOD. "Experimental Studies on Lead Therapy."
9. DR. SANFORD WITHERS. "Therapeutic Lead Poisoning."
10. DR. H. J. ULLMANN. "Observations on Lead Treatment."
Discussion: DR. ALBERT SOILAND,
DR. E. G. BECK.
11. DR. G. W. GRIER. "Radium as a Palliative Agent."
12. DR. E. G. BECK. "Open Surgery as an Aid to Efficient Post-operative Radiation and as a Prevention of Recurrence."
13. DR. M. J. SITTENFIELD. "The Relative Value of Radium in Malignant Disease."
Discussion: DR. HENRY SCHMITZ,
DR. R. L. SANTE.

July 9, 1929, morning session.

14. DR. G. E. PFAHLER. "The Treatment of Cancer of the Mouth by Means of Radium."
15. DR. ALBERT SOILAND and DR. WILLIAM E. COSTLOW. "The Treatment of Epulis."

16. DR. G. ALLEN ROBINSON. "Radium in the Treatment of Neoplastic and Diseased Tonsils."
17. DR. F. A. FIGL. "The Treatment of Malignant Tumors of the Mouth and Throat."
Discussion: DR. E. H. SKINNER,
DR. W. H. MCGUFFIN,
DR. SANFORD WITHERS.
18. DR. JAMES A. CORSCADEN. "Further Indications for the Artificial Menopause."
19. DR. E. H. SKINNER. "The Rational Uses of Radium in Hemorrhagic and Fibrotic Tendencies of the Menopausal Period."
Discussion: DR. D. T. QUIGLEY,
DR. W. E. COSTOLOW.
20. DR. SOLOMON GINSBURG. "The Value and Place of Radium in Treatment of Diseases of the Thyroid Gland."
Discussion: DR. R. E. LOUCKS.

July 9, 1929, afternoon session.

21. DR. O. L. NORSWORTHY. "A Study of the Uterine Cervix, with Special Reference to the Use of Radium."
22. DR. HENRY SCHMITZ. "Late Complications in the Urinary Tract Following Radiation Therapy for Carcinoma of the Uterine Cervix."
23. DR. H. H. BOWING and DR. J. H. BLISS. "Results Obtained in the Treatment of Cancer of the Cervix Uteri with Radium and Roentgen Rays, from 1915 to 1923, Inclusive."
Discussion: DR. ROLLIN H. STEVENS,
DR. M. J. SITTENFIELD,

All members of the Radiological Society and the Radiological Section of the American Medical Association are cordially invited to attend both the banquet and the scientific sessions.

THE INDIANA ROENTGEN SOCIETY

The second annual meeting of the Indiana Roentgen Society was held in Indianapolis, February 22. Dr. P. M. Hickey, of the University of Michigan, was the guest of honor, and gave an address entitled "Lateral Teleoroentgenography of the Chest."

Officers were elected as follows: President-elect, Dr. C. S. Oakman, of Muncie; Vice-president, Dr. K. T. Meyer, of Evansville; Secretary-Treasurer, Dr. J. N. Collins, of Indianapolis. Dr. E. M. Van Buskirk, of Fort Wayne, was appointed a member of the Executive Committee for three years.

The next meeting of the Society will be held in June, 1929, in Evansville.

Members attending were as follows: Dr. R. C. Beeler, Indianapolis; Dr. A. G. Chittick, Frankfort; Dr. J. N. Collins, Indianapolis; Dr. W. R. Cleveland, Evansville; Dr. A. C. Echternacht, Indianapolis; Dr. L. F. Fisher, South Bend; Dr. H. H. Inlow, Shelbyville; Dr. E. O. Lindenmuth, Indianapolis; Dr. C. R. LaBier, Terre Haute; Dr. R. L. Lochry, Indianapolis; Dr. D. C. McClelland, LaFayette; Dr. K. T. Meyer, Evansville; Dr. R. G. Moore, Vincennes; Dr. C. S. Oakman, Muncie; Dr. W. E. Pennington, Indianapolis; Dr. H. J. Pierce, Terre Haute; Dr. C. E. Quinn, Terre Haute; Dr. G. D. Scott, Sullivan; Dr. H. W. Sigmond, Crawfordsville; Dr. C. A. Stayton, Indianapolis; Dr. L. A. Smith, Indianapolis.

UNPROTECTED RADIUM SHIPMENTS

The arrival of shipments of unprotected radium and X-ray films in the same mail calls attention to the possibilities of irreparable damage to undeveloped films by exposure during shipment to the radiation

from unprotected radium. Not only will new X-ray films be fogged but other articles susceptible to radiation will be ruined. Nearly all amateur cinema film is sent through the mail for developing after exposure. The entire record of research or of a vacation trip might be lost in this way. Another possible, although remote, source of danger is that of injury to postal employees through contact with unprotected radium.

It seems only reasonable that all shippers of radium and radio-active substances should be required to use sufficient lead protection to insure persons handling the shipment against personal injury and to prevent damage to radiation-sensitive films and other photographic materials.

E. G. C. WILLIAMS, M.D.

A MEMBER OF THE SOCIETY IS HONORED

Dr. James M. Martin has been chosen President of the Dallas County [Texas] Medical Society, and a biographical sketch of him constitutes the leading article in the January issue of *The Dallas Medical Journal*. He has practised medicine in Dallas since 1906, is known internationally as an authority on roentgenology, and "probably has as many friends among the profession throughout the state and nation as any other man in organized medicine in Texas," to quote the *Journal*. Dr. Martin's commanding presence is seen at the annual meetings of the Society, and two years ago, at Milwaukee, he showed some of the work he has accomplished in the cure of tumors about the face and neck. His son, Dr. Charles L. Martin, associated with him in practice, likewise has done outstanding work in radiology.

FIFTEENTH ANNUAL MEETING

COMMITTEES

The following committees have been appointed to carry through to a successful climax the next Annual Meeting of the Society:

Local Executive Committee

DR. G. E. RICHARDS, *Chairman*, Toronto
Associates: DR. H. E. SCHAEF, London, Ont., and DR. A. H. ROLPH, Toronto

Publicity Committee

DR. A. H. ROLPH, *Chairman*, Toronto
Associates: DR. W. C. KRUGER, Toronto, and DR. L. R. HESS, Hamilton, Ont.

Entertainment Committee

DR. H. M. TOVELL, *Chairman*, Toronto
Associates: DR. F. C. NEAL, Peterborough, Ont., and DR. G. E. RICHARDS, Toronto

Hotels and Lodging Committee

DR. W. C. KRUGER, *Chairman*, Toronto
Associates: DR. G. E. REID, Toronto, and DR. A. E. WALKEY, Hamilton, Ont.

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DR. A. C. SINGLETON, *Chairman*, Toronto
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Banquet Committee

DR. E. H. SHANNON, *Chairman*, Toronto
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Toronto Night Committee

DR. W. J. CRYDERMAN, *Chairman,*
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Associates: DR. H. M. TOVELL, Toronto,
and DR. W. H. DICKSON, Toronto

Canadian Night Committee

DR. W. H. DICKSON, *Chairman,* Toronto

Associates: DR. A. H. ROLPH, Toronto,
and DR. R. A. THOMAS, Toronto

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MRS. W. H. DICKSON, *Vice-chairman,*
Toronto

Associates: DR. W. J. CRYDERMAN,
Toronto; DR. ELIZABETH STEWART,
Toronto, and DR. A. C. SINGLETON,
Toronto

Canadian Program Committee

DR. L. R. HESS, *Chairman,* Hamilton,
Ont.

Associate: DR. G. E. RICHARDS, Toronto

COMMERCIAL EXHIBITORS, ATTENTION!

It will be well for the Commercial Exhibitors to familiarize themselves with the laws, rules, and regulations governing the shipping of apparatus and accessories into Canada for exhibition purposes.

I am informed by the Collector of Customs at Toronto, under date of February 14, 1929, that X-ray apparatus and certain accessories are at present admitted free of duty, but that there is a sales tax of 3 per cent which, however, may be lower at the time of our proposed meeting in Toronto in December, as this tax has been lowered each year for several years.

Even if the apparatus shipped into Can-

ada is free from duty, there are certain forms and blanks to be filled out and certain other governmental "red tape" arrangements necessary. These are in part embodied in the following customs brokers' rules regarding

EXHIBITION ENTRIES

"1. All merchandise must be invoiced in triplicate on Canadian Customs 'Form N,' sworn to and mailed to us.

"2. Souvenirs and advertising matter for free distribution are dutiable. The proper value must therefore be clearly stated on invoice. The net weight of advertising matter of paper must also be shown.

"3. Invoices must show the fair market value as sold for home consumption at time shipped and must specify the number of packages comprising the shipment.

"4. These invoices must be made out showing the goods consigned to ourselves. They must be mailed to us along with a copy of the express bill-of-lading.

"5. All shipments must be prepaid and consigned to ourselves. All bills-of-lading and cases must be marked with the booth number which has been allotted to you at the exhibition.

"6. Make out three copies of U. S. Shippers Export Declaration, giving full particulars of goods, showing value, etc. Two of these must be given to the transportation company when shipping. The third copy is to be used in case of emergency and given to the U. S. Customs officials at the U. S. port of exit before crossing the border in case the other two copies have been mislaid or lost by the railway officials en route.

"7. All merchandise given away, sold or not exported will be subject to duty.

"8. We must have a power of attorney to arrange Customs clearance here.

"9. Charges: \$5.00 inwards entry; \$5.00 outwards entry; \$1.00 duty entry."

RETURN OF ABOVE MERCHANDISE

"1. Power of attorney will be required for American Consular purposes.

"2. We must be supplied with American Oath of Origin, Form No. 3311, duly sworn to in the United States.

"3. We will look after the shipping, obtain Consular invoice, copies of manifest, etc.

"4. Charges: \$2.50 Customs and American Consular charges.

"The above forms will be supplied by us upon application."

Arrangements will be made whereby the Commercial Exhibit room, at the Royal York Hotel, will be a Bonded Warehouse.

For further information or particulars, communicate with Mr. J. H. Bartram, Collector of Customs and Excise, 54 Willing St., Toronto, Ontario.

I. S. TROSTLER, M.D.

Manager of Exhibits and Transportation.

AMERICAN ASSOCIATION OF RADIOLOGICAL TECHNICIANS

The 1929 convention of the American Association of Radiological Technicians will be held in Chicago, at the Sherman Hotel, on May 27, 28 and 29. Please note the change in dates from those in the tentative announcement in February RADIOLOGY, a change made to avoid confliction with the meeting of the Illinois State Medical Society.

The new "Northwestern Limited" has been selected as the official train. This train is made up in the Twin Cities: leaves Minneapolis at 8:00 P. M., St. Paul at 8:40 P. M., and arrives in Chicago at 8:35 A. M.

The program promises to be one of unusual interest: radiographs made by technicians will be exhibited; lantern slides and moving pictures will be shown; many of the

papers presented will be discussed. In all these ways new and valuable suggestions in technic will be made.

The Wednesday morning program is to be given by members of the medical profession and promises to be one of the vitally interesting sessions of the convention.

BOOK REVIEW

DIE KLINISCHE RÖNTGENDIAGNOSTIK DER INNEREN ERKRANKUNGEN. DR. HERBERT ASSMANN, Ord. Prof. der Speziellen Pathologie und Therapie, Direktor der Medizinischen Poliklinik in Leipzig. Fourth Edition, Volumes I and II. Published by F. C. W. Vogel, Leipzig, 1928. Pages 1071. Price 70. R.M.

The fourth edition of this internationally recognized textbook of "Roentgen Diagnosis as Related to Internal Medicine" now appears in two volumes instead of one. Many chapters have been rewritten and the material and bibliography have been brought thoroughly up to date. Recent adjuncts to roentgen diagnosis, such as the use of lipiodol in the lungs and spinal canal, and ventriculography and encephalography, are given special consideration.

This book is without doubt one of the finest amongst roentgen literature, and every roentgenologist and clinician should have an intimate familiarity with its contents. It is to be regretted that an English translation is not available.

The highest electrical potential ever achieved by man, more than 5,000,000 volts, was obtained by Dr. Gregory Breit and Dr. M. A. Tuve, at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.—*Science Service.*

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Cancer Treated in General Practice by Colloidal Lead. Ernest Talbot. Brit. Med. Jour., Dec. 8, 1928, No. 3544, p. 1034.

The author reports two cases treated by intramuscular injections of "collosol lead." The first case was one of carcinoma of the right breast, removed in 1924. The second operation for recurrence in the scar was done in 1925. This was followed by roentgenotherapy. In spite of this, cancerous nodules reappeared in the skin and extended rapidly. A year after the second operation the whole of the right anterior chest wall was a mass of nodules. Further operation was refused and X-ray was continued. The patient was very cachectic and there was dullness over the upper right lobe of the lung and the mediastinum. There was difficulty in swallowing. In June, 1926, injections of the lead preparation into the gluteal region were begun. After six months of these treatments the scars on the chest wall had become more movable; the nodules in the skin had disappeared, and the patient had gained fourteen pounds in weight. On cessation of treatment there was recurrence of the skin nodules and the treatment was reinstituted, with immediate benefit. Recurrence again took place, however, on cessation of treatments, requiring a third series, and it was necessary to continue for a further six months before all the nodules disappeared for the third time. The whole period of treatment was twenty-seven months and the amount of lead element injected was 780 milligrams.

The second case was advanced carcinoma of the rectum. The surface of the growth was excavated and involved the whole surface of the bowel. The edges were raised, everted, and indurated, and bled when examined. The growth was high up in the rectum, five inches from the anal orifice, and the surrounding tissues were infiltrated. There was marked

cachexia. The same general procedure as outlined above was used in this case. At the end of six months there was a gain of fourteen pounds in weight, the patient felt better, and there was a marked improvement in the appetite. The edges of the ulcer were softer and the rectum itself could be moved more freely and appeared less fixed. There had been, however, an extension of the ulcerating process downwards. At this time, in addition to the intramuscular injections, the patient was instructed to inject the lead solution into the rectum once a week. At the time of writing, the patient had been under treatment twenty-two months and had gained twenty-four pounds, and was able to perform her household duties. The ulcerated edge of the growth has extended downwards much farther than at first and practically involves the anal canal. The rectal wall itself appears to have been replaced by a solid mass of fibrous tissue. The rectum is not so fixed as before and can be moved more freely over the sacrum. The total amount of "collosol lead" given up to the time of writing is equivalent to 650 milligrams of lead element.

The author states that both patients stood the intramuscular injections well and that there was only a slight tenderness following the injections on a few occasions. He considers that these two cases indicate emphatically that lead has a very definite and detrimental effect on cancer cells and that the intramuscular injections appear to produce the desired effect without causing acute toxic symptoms. The lives of these patients have been prolonged and they have been made more comfortable and hopeful; the author therefore feels that consideration should be given to the use of lead salts in the fight against cancer, and that the treatment does not seem to merit the wholesale condemnation it has recently received.

H. J. ULLMANN, M.D.

The Effect of Irradiation on the Suprarenal Gland. A. U. Desjardins. *Am. Jour. Roentgenol. and Rad. Ther.*, May, 1928, XIX, 453.

It is the author's belief that the experimental work tending to show that the suprarenal

glands are highly susceptible to radiation is not well founded; in fact, practical clinical experience tends to contradict it. Even after large doses in experimental work, the pathologic changes are chiefly in the cortex of the gland. While a small number of cases have been reported in which roentgen therapy is said to have induced acute suprarenal insufficiency, it is just as likely that these cases represented malignant extension or metastasis with coincident insufficiency, and to offset these few cases there have been thousands of patients receiving X-radiation to the suprarenal area without at any time developing signs of suprarenal disturbance. Because of the degree of resistance of the cells, particularly medullary, to radiation, the contention that radiation can diminish blood pressure in hypertension, or the hyperglycemia of diabetics, is not tenable.

J. E. HABBE, M.D.

Radio-biologic Investigations on Eggs of Ascaris. A. Zuppinger. *Strahlentherapie*, 1928, XXVIII, 639.

In this article, the author presents the results of his extensive and very careful experiments regarding the biologic effect of radiation. It does not lend itself very well to abridgment (120 pages), but it should be studied by everyone who is doing research along these lines. A good bibliography is appended. The following conclusions are reached: a number of precautions have to be observed when working with the eggs of *Ascaris*; they are sensitive to temperature and moisture; their sensitivity to radiation is increased with beginning gastrulation. There seems to be no difference in the mechanism of the effect between roentgen and ultra-violet rays. Intensities in the ratio from one to eight do not act alike: the longer exposure has a stronger biologic effect. If fractional doses were given for ten days, double the effect was noticed as compared with the application of a total dose given at one time. X-rays of short wave length were more effective than those of long wave length if equal doses were administered as measured by the Kuestner instrument. The distribution of intensity of radium preparation is pre-

sented, based on calculations and biological tests. This permits an expression of the radium dose in roentgen units. The death rate of the eggs of *Ascaris* is analyzed and the discrepancy between observed and calculated figures is explained.

E. A. POHLE, M.D.

Sarcoma of the Prostate Gland. Ralph E. Powell. *Can. Med. Assn. Jour.*, May, 1928, XVIII, 509.

This is a report of two cases of this rare disease, which occurred in the service of the author, in the Montreal General Hospital. One case occurred in an adult, age 63, while the other was in an infant, ten months old. Including these two, there are 93 cases now reported in the literature.

L. J. CARTER, M.D.

Non-surgical Renal Tuberculosis. Robert Gutierrez. *Am. Jour. Surg.*, August, 1928, V, 99.

The author believes that tuberculous bacilluria does not always mean renal tuberculosis, therefore, all of the clinical tests should be made. Nephrectomy should be advised only when all of the clinical tests are positive and when the kidney function is diminished and the other kidney has to function to maintain life. He believes that bilateral renal tuberculosis is more common than has ever been suspected clinically. When there is bilateral renal tuberculosis, with good kidney function on one side and diminished function on the opposite side, the more seriously affected kidney should be removed, providing that the other kidney is sufficient to maintain life. Partial nephrectomy in some instances is recommended.

Cases in which the pyelogram shows pyelonephritis and slight degree of hydronephrosis, with narrowing or stricture in the ureter sufficient to interfere with good drainage, and in which there is fairly good kidney function without any apparent lesion of the bladder mucosa, should be treated cystoscopically by the routine method of catheterization and dilatation of the ureter and irrigation of

the kidney pelvis. Many early tuberculous lesions of the kidney may be cured by this method.

H. P. DOUB, M.D.

Regarding the Treatment of Chronic Leukemia. R. Epstein. *Strahlentherapie*, 1928, XXVIII, 799.

The author contends that in many articles dealing with the radiation therapy of leukemia, unnecessarily high doses are recommended. These are decidedly dangerous and do not lead to therapeutic results. There is no universal dose which will be advisable in every case; the treatment has to be individualized. There are patients who respond to small and medium doses given over a long period; in some cases the dose has to be slightly increased; there are patients who do not respond at all or should not be treated because of cachexia. In a number of cases the high blood count drops but the spleen remains enlarged. Besides the exposure of the spleen, the bones and the liver may be irradiated. The efficacy of this procedure has, however, been questioned. There is no sense in trying to reduce the white blood count completely to normal by administering high doses. It is often satisfactory to stop treatment for a while if the leukocytes have gone down to about 20,000. It is interesting to note that some cases respond to doses as low as 2 per cent of the S.U.D. over the spleen if deep therapy radiation is used.

E. A. POHLE, M.D.

The Significance of Petrous Ridge Deformation in the Roentgen-ray Diagnosis and Localization of Brain Tumors. Henry K. Pancoast. *Am. Jour. Roentgenol. and Rad. Ther.*, September, 1928, XX, 201.

In addition to the generally recognized evidence of brain tumor such as calcification in cyst walls, hyperostoses associated with meningiomas, sellar deformations in hypophyseal tumors, shift of the calcified pineal gland from its normal position, bone atrophy, and local pressure effects, the author finds erosion or atrophy of a localized portion of the pe-

trous ridge of the temporal bone of definite value in aiding in the localization of cerebellar and angle tumors. The petrous ridges are best visualized by the occipital projection, which yields information regarding these structures which cannot be obtained by stereoscopic lateral roentgenograms.

Because slight depressions have been noted in the petrous ridges (more often the right) in normal skulls, slight depressions should not be considered reliable. However, slow-growing tumors may produce, either by direct contact or by transmitted pulsation, a definite erosion of the petrous ridge, or by obstruction to the lateral sinus with resultant dilatation of that vessel a localized pressure atrophy of the adjacent bone, and these X-ray findings, taken in conjunction with the clinical data, may be most valuable and reliable in aiding in the localization of the tumor. Petrous ridge deformations will probably not be present in rapidly growing tumors where the course of the disease is short.

J. E. HABBE, M.D.

Regarding Radiotherapy of Genital Tuberculosis in Women. G. A. Wagner. *Strahlentherapie*, 1928, XXVIII, 759.

In the author's clinic, radiation therapy of genital tuberculosis is given in preference to operation. Forty-two cases were treated in the years 1921-27. In the first group were fourteen patients who also had a peritoneal tuberculosis with ascites; of these, three were cured, five improved, and three did not respond. In the second group were eighteen cases (where the peritoneum was not affected); in sixteen cases satisfactory results could be recorded; one of the patients, who was irradiated in 1925, delivered a normal child in 1927, and was pregnant again at the time this paper was written. The third group consisted of two cases of uterine tuberculosis, one of which was cured and the other operated on later. In the fourth group, seven patients were treated following operation in which the nature of the disease was verified. The results appeared to be satisfactory. During the first two years, from 30 to 50 per cent

of the S.U.D. was given. The results showed definite improvement when these doses were reduced to from 10 to 15 per cent S.U.D. effective in the diseased area. The treatments were repeatedly given at intervals of from four weeks to several months. There is scarcely any contra-indication to radiotherapy in this type of case. The author goes so far as to interrupt any intended operative procedure, if, after the abdomen has been opened, a diagnosis of tuberculosis of the genital organs can be made.

E. A. POHLE, M.D.

Chronic Cystic Mastitis—Its Relation to Cancer of the Breast. Alson R. Kilgore. *Calif. and Western Med.*, November, 1928, XXIX, 289.

Not a little confusion of opinion has existed—and still does—on the question of the precancerous breast cysts. The term "chronic cystic mastitis" is perhaps a misnomer, since inflammation plays no active part in the production of these cysts. Abnormal involution is perhaps nearer the truth. The chief common characteristic of all forms and stages of abnormal involution is an increase in the number of individual gland elements—ducts or acini or both.

Inasmuch as cancer arises from epithelium and only epithelium we would not expect to see it often originate where there is little or no epithelium, as in the smooth-walled serous or "blue-domed cysts." Furthermore, it is, in general, a characteristic of cancer to arise in abnormal rather than normal epithelium. It is expected to arise in cysts or duct adenomas where the epithelium is increased and abnormal in its growth and arrangement. In a small group of cases (4), one-third of the cystadenomas have presented cancer at the time of operation. On the other hand, thirty presenting the non-productive type of chronic cystic mastitis have been studied and in none of these has cancer been found.

The two great types of abnormal involution usually present gross features permitting recognition at the operating table. The non-productive type presents one or many, large

or small, smooth-walled serous cysts, with breast tissue presenting the usual mixture of fat and fibrous stroma of normal color and fairly normal elasticity. The productive type presents single or multiple papillomatous cysts or a diffuse process of small cysts filled with whitish-yellow necrotic material. The entire mass is typically harder and less elastic than normal breast tissue and often presents a distinct yellowish tinge on cut section.

F. B. SHELDON, M.D.

Radium Treatment of Certain Types of Metabolic Diseases in Connection with a Special Diet. M. Heiner. *Strahlentherapie*, 1928, XXVIII, 788.

Forty-eight patients suffering from some type of metabolic disease were treated with radium bath, radium injections, radium irradiation, or radium internally. A special diet consisting of 57 grams albumin, 72 grams carbohydrate, and only butter as fat, per day, was given at the same time. It appeared that in many of these cases the blood sugar before breakfast was increased. A drop of this high blood sugar during the treatment was accompanied by an improvement of the clinical symptoms.

E. A. POHLE, M.D.

Radium Treatment of Tonsils and Other Lymphoid Tissue in the Throat. Francis H. Williams. *Am. Jour. Roentgenol. and Rad. Ther.*, April, 1928, XIX, 334.

The author used 55 mg. of radium in a pure gold container so designed as to direct the beta rays over the tonsil only. The usual filter is 0.6 to 0.7 mm. aluminum, and an application of six to ten minutes is made to each tonsil. The result sought for is the complete eradication of all diseased lymphoid tissue, a small fibrous tonsil resulting after three or four treatments at intervals of about three weeks have been given. It is felt that by this method of treatment there will be fewer recurrences than when tonsillectomy is per-

formed. In addition to the several operative dangers or complications which are all avoided by the radium method, the author points out that diseased lymphoid tissue of the pharynx or other parts of the throat can be treated as effectively by the radium method as the tonsil area.

J. E. HABBE, M.D.

A Rare or Hitherto Unrecorded Cavity with Fluid in the Bony Nasal Septum and the Crista Galli. Virgil J. Schwartz. *The Laryngoscope*, May, 1928, XXXVIII, 347.

The author was unable, after a rather extensive search of literature, to find any previous report of such a case. His patient, who was 20 years of age, had a severe nasal obstruction. The septum was very thick and moderately deviated, with a definite spur to the left. During a sub-mucous resection the septum was found to contain a cavity, filled with fluid, which extended about one centimeter above the cribriform plate. This apparently went into the crista galli. He was unable to ascertain whether this cavity connected with the frontal sinus or with any of the ethmoid cells. The cavity was about one-half inch long (anterior-posterior), and from one-eighth to one-fourth inch wide and contained from 3 to 6 c.c. of fluid.

Dr. Schwartz goes on to explain how such a cavity might be formed in the embryo or by pneumatization from the frontal or ethmoid cells. He then studied a series of 807 films of the accessory nasal sinuses in which he found 518, or 64 per cent, with a solid bony crista galli and septum; 142, or almost 18 per cent, showed a crista with a center of loose cancellous bone; 136, or 17 per cent, showed a pneumatized more or less distended crista galli, while 19, or more than 2 per cent, presented a definite cavity in some part of the bony septum with or without a pneumatized crista. Some of these were pneumatized from the frontal sinuses above or apparently from the sphenoids behind. The author has shown that this subject has a very

definite anatomical, clinical, and surgical significance.

B. C. CUSHWAY, M.D.

The Musculature of the Bronchi and Lungs. Charles C. Macklin. *Physiological Rev.*, January, 1929, IX, 1-60.

X-ray examination has been heavily drawn upon in this review in visualizing the length and width changes in the bronchi during respiration. In inspiration there is elongation, with widening of the tubes, and in expiration shortening, with narrowing. The bronchial musculature is a continuous network extending throughout the bronchial tree, and its structure adapts it to function in the expiratory phase, for its contraction must shorten and narrow the tubes, particularly at the outer, or respiratory, end. This latter region has been shown to be very complex, and here the muscle forms a contractile spongework, its fibers encircling the numerous openings in the walls of the tubes, and edging the inter-alveolar partitions. There is an intimate mixture of elastic fibers with the muscle, which is thus in a position to act in conjunction with the elastic recoil. The innervation of this muscle system is reviewed, and a hypothesis advanced of an antagonistic action between it and the chest wall and diaphragm.

The conception of the dead space is re-cast, and it is presented in an anatomical manner as a variable quantity, synonymous with bronchial capacity.

X-ray examination, too, shows that, when thick exudates block the bronchi, there is developed a peristaltoid movement to effect their removal. Indeed, this form of movement, in slight degree, may be a constant phenomenon.

Pathological conditions, as asphyxia, asthma, and anaphylaxis, are reviewed, and the bearing of the muscle on them considered.

There is an exhaustive review of the pharmacology of the bronchial musculature.

Besides the muscle intimately related to the walls of the airway, there is a system of fine fibers in the interstitial tissue.

Some 492 separate articles are reviewed and their substance classified. The conception of

the lungs as muscular organs should lead to advances in the understanding of these organs and in the treatment of their diseases.

On the Influence of Roentgen Rays on the Carbohydrate Metabolism of Carcinoma of the Cervix. K. Jaroschka. *Strahlentherapie*, 1928, XXVIII, 784.

Patients suffering from carcinoma of the cervix were treated with roentgen rays on three successive days, the total dose effective in the tissue amounting to 110-120 per cent S.U.D. This corresponds to 650 R per field. Biopsies were taken before and after the irradiation. It was found that the glucose content of the irradiated cancer tissue was more than three times as high as that of the untreated tumor tissue. The results were the same whether or not an intravenous glucose injection was given in connection with the roentgen-ray treatment.

E. A. POHLE, M.D.

Peptic Ulcer of the Esophagus. Julius Friedenwald, Maurice Feldman, and Waitman F. Zinn. *Am. Jour. Med. Sci.*, January, 1929, CLXXVII, 1.

Peptic ulcers of the esophagus occur frequently enough to be of clinical importance. The usual location is in the lower third, although they may be found higher. The etiology is similar to that of peptic ulcers in the stomach and duodenum. In order that this affection may occur, it is necessary that the cardia remain patent so that regurgitated acid may continue its corrosive effect.

Peptic ulcers of the esophagus are found mostly in adults. The most prominent symptoms are pain, dysphagia, vomiting, hemorrhage, and perforation. The treatment consists in the eradication of foci of infection, rest, regulation of diet, olive oil, alkalies, and belladonna.

The roentgenological appearance presents four types of defect: (1) Mucosal erosion. In this type, a small fleck of barium may remain. There is also usually a spastic phenomenon present. (2) Niche or penetrating. This

is the most frequent. A small amount of barium may be seen to remain after the rest of the esophagus is empty. It resembles the niche seen in gastric ulcers. At times it may resemble a dilatation or a diverticulum.

(3) Spastic defect may be noted as:

- (a) simple transient spasm causing a delay to the passage of the meal;
- (b) a tapering defect of the esophagus toward the cardia;
- (c) an indentation resembling an incisura seen in a gastric ulcer.

(4) Perforating type. This is rarely seen at X-ray examination, as the patient is usually too sick to be submitted to such a procedure.

ROBERT A. ARENS, M.D.

New Observations Regarding the Question of Injury to the Offspring Following Irradiation of the Ovaries. Walther Schmitt. *Strahlentherapie*, XXX, 24.

The problem of injury to the offspring of women whose ovaries were treated by roentgen rays or radium is still under discussion. In this paper, the author presents his own observations based on 42 pregnancies in 25 women patients of the gynecological clinic of the University of Wurzburg. Thirteen of the 25 patients received a dose sufficient to produce permanent amenorrhea; 19 pregnancies were observed in this group—3 ended in abortion, 15 in delivery of a living child. Eight patients received treatment for irregular or excessive menstruation without aiming at permanent amenorrhea. From 17 pregnancies in this group, 5 ended in abortion and 12 patients delivered living children. Three women received a temporary sterilization dose; there were four pregnancies in this group, which were normal. One patient received a small dose to the ovary in order to stimulate its function; she had two pregnancies, one came to full term and the other ended in the ninth month. Of the 35 living children, 14 males and 21 females, 28 were absolutely normal at birth, 4 were underweight, 3 were born prematurely. None of the children showed any abnormality at birth. In one child, a con-

genital heart lesion was diagnosed at one and one-half years. Six of the children died. Of the 29 who remained alive, 21 were presented in the Clinic for examination: two were not normal, one having a disturbance in metabolism and another showing a swinging motion of the head while sitting. The remaining 19 were perfectly normal. Their weight and height deviated in both directions from the normal average and in only four cases were they so much below the normal that one might speak of under-development. All four children, however, were living under very poor conditions.

The author concludes that no definite signs of injury to the offspring due to radiation could be demonstrated, but that it is generally recognized that the utmost caution is indicated in any ovarian irradiation in women before the menopause.

E. A. POHLE, M.D., PH.D.

Uterine Hemorrhage and Its Treatment. Thomas S. Cullen. *Can. Med. Assn. Jour.*, October, 1928, XIX, 411.

In those types of bleeding in which radium and X-ray come into consideration in treatment, the author gives the following advice:

Hyperplasia in young persons calls for curettage, every few months, if the bleeding is excessive. In patients at, or near, the menopause a dose of radium will bring on the menopause. In carcinoma of the cervix, when the growth is limited to the cervix, the uterus freely movable, and the patient a good surgical risk, the uterus should be removed. On the other hand, if the patient is very anemic, has renal or cardiac trouble, or if the growth has extended to the vaginal vault, then radium seems to offer the best chance of relief. In cases of carcinoma of the body of the uterus, we invariably do an abdominal hysterectomy. This usually gives excellent and permanent relief.

Small and medium sized fibroids yield readily to radium and X-ray, but one is not always sure of the diagnosis. The treatment of fibroids is under the careful scrutiny of many surgeons and radiologists, and in due time we

shall have clear indications when to operate and when to rely on radium and X-ray.

L. J. CARTER, M.D.

On the Production, the Use in Radiology, and the Dosage of X-rays of Very Long Wave Length (Up to 8 Ångströms). M. A. Dauvillier. *Arch. d' Electr. Med.*, July, 1928, XXXVI, No. 538, pp. 290-300.

The author has constructed a practical generator for X-rays of very much longer wave length (8 Å. at 1.5 K.V.) than those produced in Lindemann tubes (2 Å. at 6 K.V.). A tube is used with a transparent window of a very thin organic membrane and anticathodes of Mg, Al, W, Si, which produce an intense characteristic radiation. The quality of the radiation was determined by absorption analysis in air and in cellophane. On the average, 1 cm. of air or 0.02 cm. of cellophane reduces the radiation intensity to one-half its value. The dosage was determined by means of an air ionization chamber, which easily absorbed the total radiation. One-tenth mm. of epidermis also absorbs the total radiation and therefore acts as a "black body." For this reason the doses can also be expressed in erg per sec. and per cm.² For 3 K.V. and 100 ma. the erythema is obtained in 15 sec., corresponding to a dose of 1,155 ergs.

OTTO GLASSER, PH.D.

Clinical Difficulties Encountered in Cutaneous Roentgen Therapy. George M. MacKee. *Am. Jour. Roentgenol. and Rad. Ther.*, August, 1928, XX, 121.

During irradiation of diseased skins many objectionable conditions may arise which are in no way attributable to the treatment. Many skin diseases have concomitants, an example of which is dermatophytide, which often accompanies dermatophytosis which might be mistaken for an exacerbation, extension, or toxic rash produced by the treatment. Similarly, spontaneous exacerbations may appear to be due to the treatment. Irritating topical

remedies may produce reactions which might be ascribed to the irradiation. Occasionally a patient treated for one disease will independently develop a second, which, to him, seems an untoward reaction from the X-ray or radium. The clever malingerer may produce a dermatitis artefacta, which may closely resemble a radiodermatitis.

There are many possible sequelæ of certain skin diseases which often result with no irradiation; however, when the patient has received such treatment and develops a sequela he or some other individual is very apt to ascribe it to the X-ray or radium used. Examples are the atrophic telangiectatic skin which may be the sequela of lupus vulgaris and angiomata, the depigmented areas in psoriasis, keloid, or lichen planus, the permanent alopecia of lupoid sycosis and chronic pyogenic folliculitis, and the pitted scarring and hypertrichosis of acne vulgaris.

Sterility may have been present previous to treatment in the male who has been given treatments for a disease of the scrotum, hence, for the protection of the radiotherapist, the semen should be examined before and during the administration of treatments.

Certain skin diseases, notably psoriasis, may become roentgen-ray fast, especially if the treatment is pushed. Most of the skin diseases amenable to roentgen or radium therapy will do as well or better with mild, widely spaced treatments as when resolution is forced. A prolonged rest period is perhaps the most valuable means of overcoming a roentgen-ray fast eruption and of making it again radio-sensitive.

There is no proof that telangiectasia may develop without an antecedent erythema, however, the danger lies in overlooking the erythema in an already inflamed skin.

Since a thorough knowledge of dermatology and of all forms of dermatologic treatment is essential, the treatment of skin diseases by X-ray or radium should be conducted or supervised by a dermatologist.

J. E. HABBE, M.D.

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